



411 4<sup>th</sup> Avenue  
Fairbanks, AK 99701  
Phone: (907) 474-2011  
Fax: (907) 474-2001

[www.allalaskagasline.com](http://www.allalaskagasline.com)

# Appendix X - Z

## Binder 9

AGIA License Application  
November 30, 2007

Board of Directors:

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Dave Cobb, Secretary • Luke Hopkins • Dave Dengel • Rex Rock • Randy Hoffbeck • Harold Curran



# APPENDIX X

Environmental Impact Statement,  
Supplemental Submission to  
U.S. Bureau of Land Management





Category: Federal ROW  
YPC-ID#: 271  
Key Word #1: EIS  
Key Word #2: Federal ROW  
Key Word #3: Supplemental information

457

February 23, 1987

Mr. Jules Tileston  
Project Officer - TAGS  
Bureau of Land Management  
U.S. Department of the Interior  
701 C Street, Box 30  
Anchorage, Alaska 99513

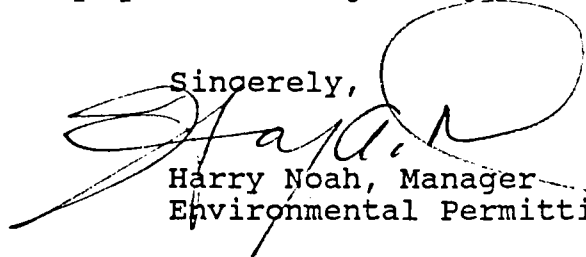
re: S.N. - TAGS - 0037  
Compliance for the Amended Application

Dear Mr. Tileston:

In response to your letter of January 23, 1987, the supplemental information which BLM has requested to aid in the development of the Environmental Impact Statement and adjudication of the Right-of-Way grant for the TAGS project is attached. This information is provided in the same order as requested in your January 23rd letter.

Please call me if you have any questions regarding our response.

Sincerely,



Harry Noah, Manager  
Environmental Permitting

HN:lrn

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ATTACHMENT 1

Response to BLM Request for Supplemental Information

1. Indicate whether YPC has top-filled [sic] the ANGTS Federal right-of-way or State right-of-way application (see NAPC comments dated 11/25/86).

Yukon Pacific Corporation (YPC) has not requested use of federal lands granted to the ANGTS project, with the exception of pipeline crossings or other unavoidable situations. It is YPC's understanding that the ANGTS project has not received a State of Alaska grant of Right-of-Way. To the best of our knowledge, however, the proposed TAGS route is not superimposed on the ANGTS route over state lands.

2. Discuss revenues to be generated by the proposed export of Liquid Natural Gas (LNG) in terms of the United States balance of payments deficit.

The TAGS project would generate approximately 2.5 billion dollars a year in gas sales, assuming that fourteen millions tons of gas is sold per year at four dollars per thousand cubic feet (MCF).

Although gas sales contracts are not yet complete, a reasonable breakdown of gas volumes by customer could be:

Japan	7 million tons/year
Korea	6 million tons/year
Taiwan	1 million tons/year

3. Discuss land availability and resources needed to provide the quantities of conditioned pipeline quality gas for the TAGS project. Special attention needs to be given the statement by NAPC that its authorized facility is not available for TAGS use. Accordingly, is there space available to construct any additional gas conditioning facilities as either stand-alone facilities or as an expansion of existing facilities? Describe any significant air quality issues.

Yukon Pacific Corporation (YPC) believes that the gas conditioning facility (GCF) for the TAGS project is most logically located near the central compressor plant and the NGL/EOR plant on the North Slope. Further, YPC is aware of no formal land rights which Northwest Pipeline Company has to this site. However, if the so-termed Northwest gas conditioning plant site is not available at the time a YPC

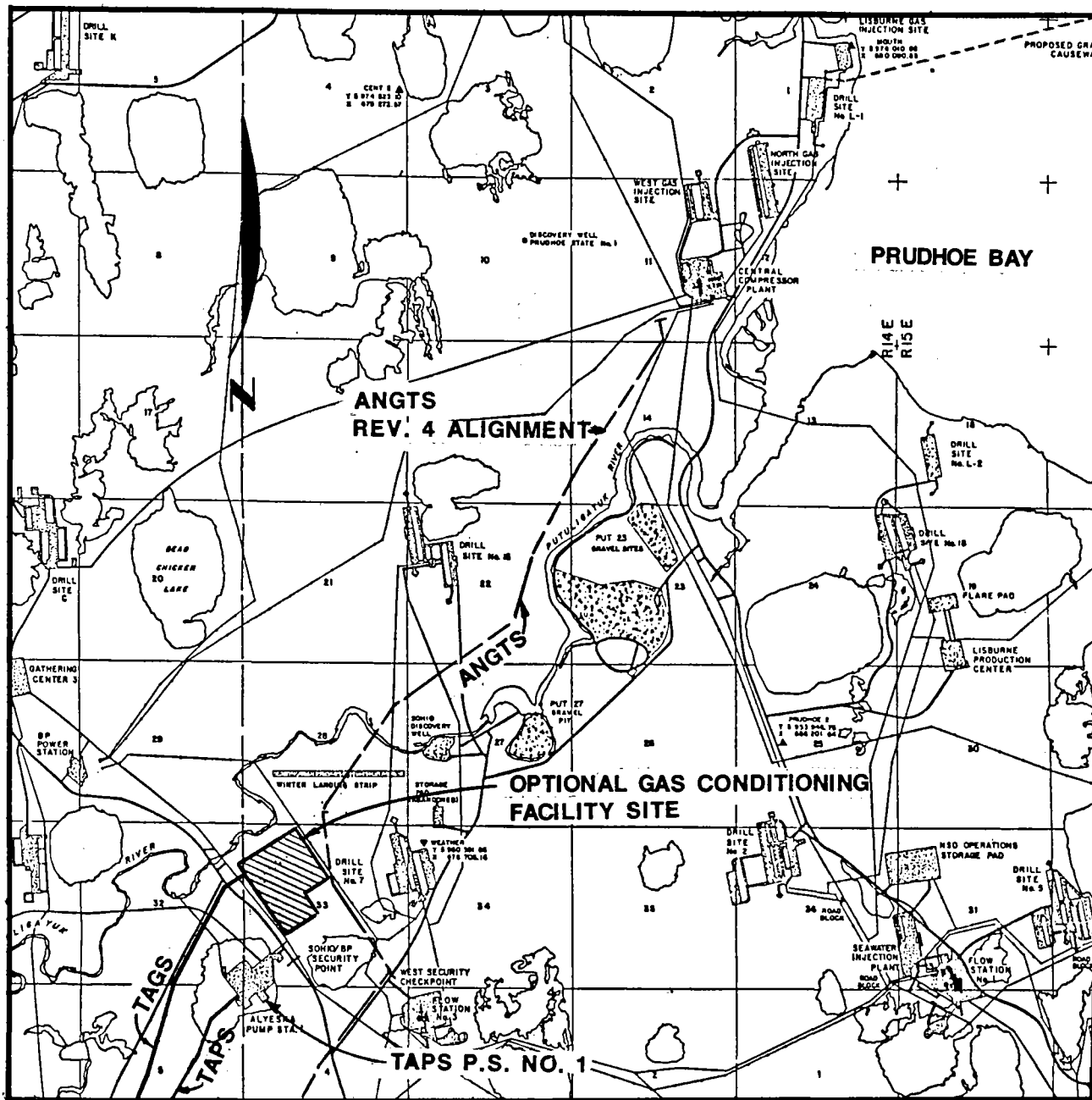
gas treatment facility is to be constructed, there are a number of alternative sites available.

YPC has identified an optional site (see Figure 1) that would provide sufficient land area for construction and operation of a GCF. The total land area needed for this GCF is 100 acres. This optional site represents only one of a number of alternative locations for a GCF.

YPC has undertaken an air quality screening analysis to determine if this site can meet the necessary air quality emission requirements. A review of the potential effects of a GCF on the local airshed is presented as Attachment 2. This analysis shows that compliance with federal and state air quality standards is possible, even using extremely conservative data in the analysis.

4. Identify an option for routing TAGS to the east of Galbraith Lake in sufficient detail that the environmental effects can be evaluated in the EIS.

The preferred TAGS route is located on the west side of Galbraith Lake and the Atigun River valley from approximately Milepost 137 to Milepost 164 at the base of Atigun Pass. This alignment allows an optimum route above the active floodplain but avoids, where possible,



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YUKON PACIFIC CORPORATION  
 TRANS-ALASKA GAS SYSTEM

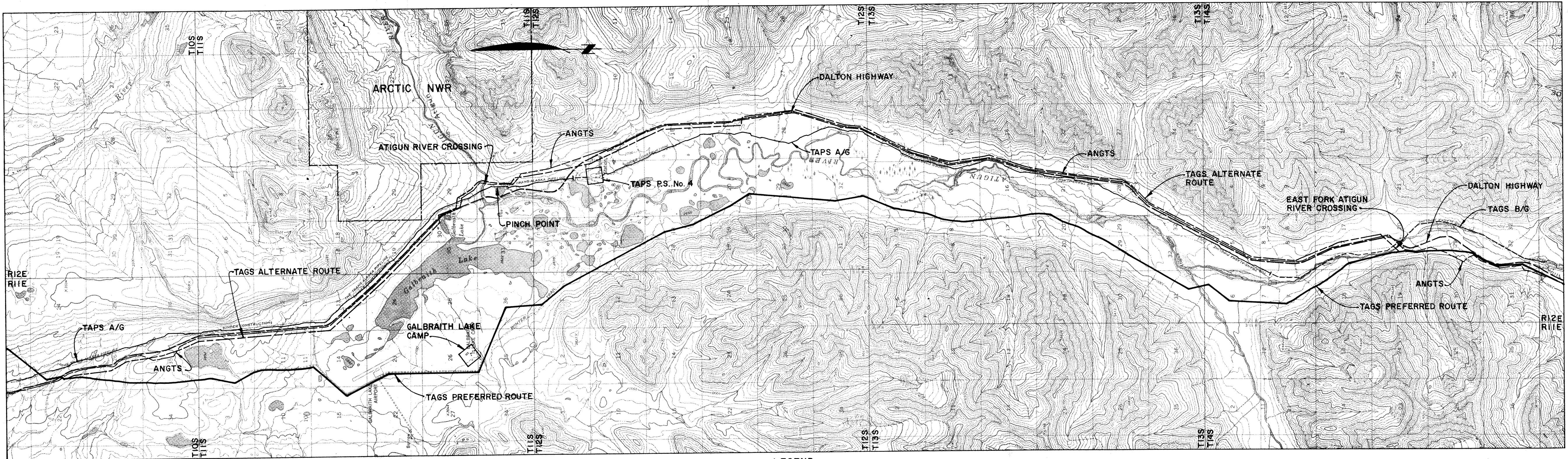
TAGS ALTERNATE  
 GAS CONDITIONING  
 FACILITY LOCATION

traversing higher elevations and steeper cross slopes on valley walls.

An alternative route has been evaluated on the east side of the Atigun River valley from a point north of Galbraith Lake to the Dalton Highway crossing of the east fork of the Atigun River. This routing alternative is shown on Figure 2 at a scale of 1:63,360, and is parallel and more closely located to the Dalton Highway, TAPS, and ANGTS alignments. Both routes evaluated are equivalent in length, but vary in technical difficulty. The alternative route on the east side of the valley was rejected by YPC for the following reasons:

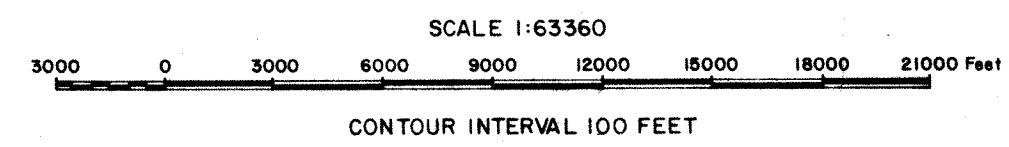
1. For the alternative route, a TAGS crossing of the Atigun River located downstream of the existing TAPS bridge and Dalton Highway bridge does not leave sufficient space between TAPS and the mouth of Atigun Gorge for both the ANGTS and TAGS pipelines. The potential problems associated with a major river crossing at this location include soil conditions, the ANGTS right-of-way which encroaches on the mouth of Atigun Gorge, and the potential for pipeline layout conflicts in the narrow valley bottom.

Alyeska encountered fine-grained ice rich soils and



**LEGEND**

- EXISTING DALTON HIGHWAY
- PROPOSED TAGS PIPELINE (B/G)
- EXISTING TAPS PIPELINE (B/G)
- EXISTING TAPS PIPELINE (A/G)
- PROPOSED ANGTS PIPELINE (B/G)
- ALTERNATE TAGS PIPELINE (B/G)



**YUKON PACIFIC CORPORATION**  
**TRANS-ALASKA GAS SYSTEM**

**TAGS ALTERNATE**  
**GALBRAITH LAKE**

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massive ice beneath a shallow (4 to 8 foot) active layer in the active floodplain of the river, and designed an aboveground TAPS crossing. TAGS preliminary evaluation of this crossing suggests that a bridge may be the best solution. This solution would minimize disturbance of the river thermal regime and the potential for thaw instability and hydraulic erosion which could affect adjacent facilities during the dormant period.

The anticipated geotechnical conditions at this crossing suggest the need for relatively large separation distances between existing and future pipelines in order to minimize adverse impacts and to ensure compatibility between pipelines. There does not appear to be adequate space for two additional pipelines, especially if a buried crossing is used by either TAGS or ANGTS.

2. For the alternative route, a major pinch point in close proximity to TAPS is located near TAPS Remote Valve #26 on the south bank of the Atigun River, between the river crossing and Alyeska Pump Station Four. Pipeline routing through this pinch point is restricted by the Dalton highway, the Atigun River and a lake to the west, and the Arctic NWR and a steep valley slope to the east. The pinch point requires

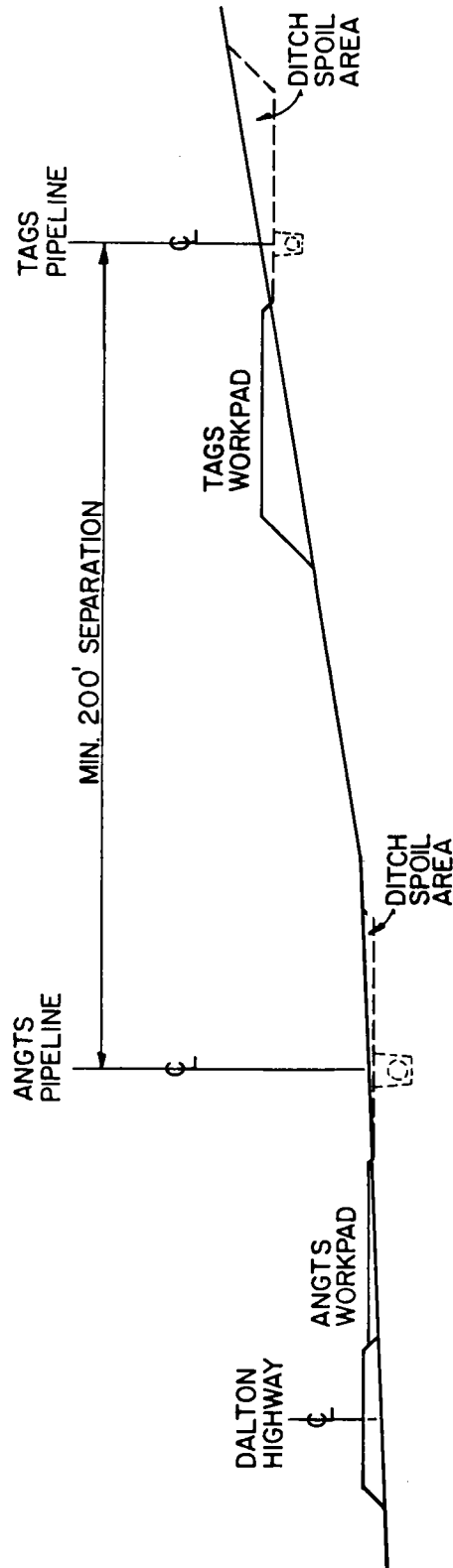
routing of future pipelines on a steep cross slope uphill of a TAPS aboveground section and the TAPS buried fuel gas line. Preliminary evaluations suggest there may be insufficient space to assure construction safety for two additional pipelines upslope of TAPS.

3. For the alternative route, the TAGS crossing of the east fork of the Atigun River near the Dalton Highway Bridge must be combined with a crossing of a belowground section of TAPS in the active floodplain. Although the route option considered begins on the east side of the valley, a crossing of the Atigun River is required at this location to avoid steep and potentially unstable slopes on the east side of the valley approaching Atigun Pass. TAPS is buried in the active floodplain of the Atigun River throughout this section. A buried TAGS crossing of the river combined with a crossing of TAPS would require that the TAGS overbend on the east side of the crossing be placed in the active floodplain. Locating the overbend in the active floodplain would require the construction of a protective river training structure. Constriction of the river channel is a concern since this area is an area of potential aufeis formation.

4. In order to accommodate the alternative routing parallel to TAPS, the Dalton Highway, and the ANGTS right-of-way on the eastern side of the Atigun Valley, the TAGS route must be located upslope on terrain with steeper cross slopes. This higher elevation route, illustrated in Figure 3, results in greater soil cuts, more extensive construction zone grading, increased gravel requirements, and a greater potential for soil slope instability and erosion. In addition, the eastern routing increases congestion along the Dalton Highway and adds four TAGS crossings of the Dalton Highway, two crossings of TAPS, and six crossings of the ANGTS right-of-way.

5. Identify all proposed major access roads between existing highways and the proposed TAGS alignment. Also identify whether such main access routes require permanent access for the project life.

Yukon Pacific Corporation (YPC) estimates that approximately 117.4 miles of access roads will be required to reach the pipeline right-of-way and associated facilities from existing public roadways. It is estimated that 33.6 miles of newly constructed access roads will be required. The remaining 100 miles of planned access roads includes the use of active and inactive existing access roads.



GENERALIZED SECTION FOR ALTERNATE TAGS ROUTE ON  
EAST SIDE OF ATIGUN VALLEY, SOUTH OF TAPS P.S. NO. 4  
 View Looking North

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YUKON PACIFIC CORPORATION  
 TRANS-ALASKA GAS SYSTEM

TAGS ALTERNATE  
 GALBRAITH LAKE AREA  
 GENERALIZED SECTION

Figure 3

Major access roads of significant length are identified on the TAGS route maps dated 12-1-86 (1:250,000 scale). Table 1 lists major access roads, identifying each access point by TAGS milepost, indicates whether the access route is to be new construction or reused existing facilities, and the approximate access route length. Additional required access roads to such areas as material and disposal sites will be defined during later project development stages once these sites are identified. All needed permits and/or authorizations for each access road will be obtained before construction begins.

Permanent access roads for permanent use will be identified during detailed design stages of the project. Permanent access requirements will depend upon the overall needs of the TAGS operations and maintenance programs, which will be developed along with detailed design. In general, TAGS conceptual planning for design, operations and maintenance assumed minimum permanent access requirements.

Table 1  
TAGS Access Roads

<u>Milepost</u>	<u>Description</u>	<u>Estimated Length</u>
22.5	new	3.1 miles
34.3	new	1.2 miles
46.3	new	0.6 miles

Table 1 (continued)  
TAGS Access Roads

<u>Milepost</u>	<u>Description</u>	<u>Estimated Length</u>
66.5	new	1.3 miles
71.8	new	0.1 miles
74.2	new	0.1 miles
77.4	new	0.1 miles
81.9	new	0.1 miles
88.1	new	0.1 miles
92.1	new	1.2 miles
115.0	reuse	0.5 miles
121.5	new	0.1 miles
125.5	reuse	0.2 miles
140.0	reuse	2.1 miles
148.6	reuse	0.9 miles
	new	0.3 miles
173.9	new	0.5 miles
176.5	reuse	0.3 miles
183.5	new	0.1 miles
191.4	new	0.1 miles
195.0	new	0.1 miles
198.5	new	0.2 miles
203.0	new	0.1 miles
208.2	reuse	0.2 miles
213.9	new	0.2 miles
218.5	new	0.1 miles
223.0	new	0.1 miles
224.3	reuse	0.1 miles
231.0	reuse	0.1 miles
236.2	reuse	0.1 miles
238.6	reuse	0.1 miles
246.0	reuse	0.4 miles
252.1	new	0.1 miles
253.4	reuse	0.1 miles
256.9	reuse	0.1 miles
261.6	reuse	0.3 miles
264.0	new	0.1 miles
270.5	reuse	0.7 miles
	new	0.2 miles
272.3	reuse	0.7 miles
	new	0.6 miles
277.6	reuse	0.9 miles
	new	0.2 miles
281.0	reuse	0.7 miles
	new	0.5 miles
283.3	reuse	0.4 miles
286.0	reuse	0.2 miles
290.1	reuse	1.1 miles
	new	0.6 miles
291.2	reuse	2.2 miles
	new	0.4 miles

Table 1 (continued)  
TAGS Access Roads

<u>Milepost</u>	<u>Description</u>	<u>Estimated Length</u>
293.2	reuse	1.7 miles
	new	0.4 miles
294.2	reuse	1.2 miles
	new	0.2 miles
296.3	reuse	0.3 miles
298.9	reuse	0.1 miles
300.0	reuse	0.1 miles
304.9	new	0.1 miles
309.0	reuse	0.2 miles
312.0	reuse	0.2 miles
313.8	new	0.1 miles
315.8	new	0.1 miles
317.8	new	0.1 miles
319.6	reuse	0.1 miles
324.5	new	0.1 miles
325.7	reuse	0.4 miles
328.4	reuse	0.8 miles
	new	0.2 miles
330.3	new	1.8 miles
335.7	new	1.6 miles
340.2	reuse	0.8 miles
342.8	reuse	0.2 miles
	new	0.3 miles
345.3	reuse	0.5 miles
348.9	reuse	0.2 miles
349.4	reuse	5.5 miles
	new	1.0 miles
355.5	reuse	0.2 miles
357.0	reuse	0.6 miles
	new	0.7 miles
360.2	reuse	0.1 miles
362.1	new	0.1 miles
363.9	reuse	0.5 miles
369.7	reuse	0.1 miles
371.5	reuse	0.1 miles
374.1	reuse	1.0 miles
379.5	new	2.4 miles
385.7	reuse	2.0 miles
386.9	reuse	0.6 miles
391.0	reuse	0.3 miles
	new	0.3 miles
400.5	reuse	8.5 miles
	new	0.5 miles
408.5	reuse	0.3 miles
410.6	reuse	0.5 miles
415.2	reuse	0.1 miles
417.2	reuse	0.1 miles
418.4	reuse	0.7 miles

Table 1 (continued)  
TAGS Access Roads

<u>Milepost</u>	<u>Description</u>	<u>Estimated Length</u>
420.9	reuse	0.2 miles
425.7	reuse	2.8 miles
428.5	reuse	1.6 miles
430.1	reuse	3.5 miles
432.7	reuse	2.9 miles
436.1	reuse	2.4 miles
486.0	new	4.5 miles
512.2	reuse	0.5 miles
517.9	reuse	0.8 miles
548.5	reuse	2.8 miles
551.0	reuse	3.4 miles
556.1	reuse	0.4 miles
561.7	reuse	0.5 miles
562.2	new	0.8 miles
564.6	reuse	0.3 miles
568.3	reuse	0.2 miles
569.6	reuse	0.3 miles
572.3	reuse	0.2 miles
580.0	new	0.1 miles
581.8	new	0.2 miles
590.6	reuse	1.8 miles
591.4	new	0.9 miles
607.1	new	0.3 miles
609.0	new	0.2 miles
620.3	reuse	0.4 miles
623.0	reuse	0.1 miles
624.6	reuse	0.3 miles
632.2	reuse	0.2 miles
634.4	reuse	0.7 miles
635.1	reuse	0.2 miles
639.1	new	0.5 miles
642.6	reuse	1.0 miles
664.0	reuse	3.5 miles
671.7	reuse	1.2 miles
674.0	reuse	0.3 miles
680.5	reuse	1.6 miles
688.7	reuse	0.9 miles
689.0	reuse	0.6 miles
691.1	reuse	0.4 miles
695.2	new	0.6 miles
699.7	new	2.0 miles
707.2	reuse	0.5 miles
	new	0.6 miles
715.0	reuse	0.2 miles
720.6	reuse	0.4 miles
731.1	reuse	0.3 miles
734.6	reuse	0.1 miles

Table 1 (continued)  
TAGS Access Roads

<u>Milepost</u>	<u>Description</u>	<u>Estimated Length</u>
737.1	reuse	0.3 miles
755.5	reuse	0.2 miles
757.2	reuse	1.1 miles
759.4	reuse	0.3 miles
768.6	reuse	0.3 miles
769.6	reuse	0.1 miles
775.3	reuse	1.8 miles
784.1	reuse	1.1 miles

6. Clarify how TAGS proposes to cross Atigan [sic] Pass, taking into account the approved Revision 4 location of ANGTS.

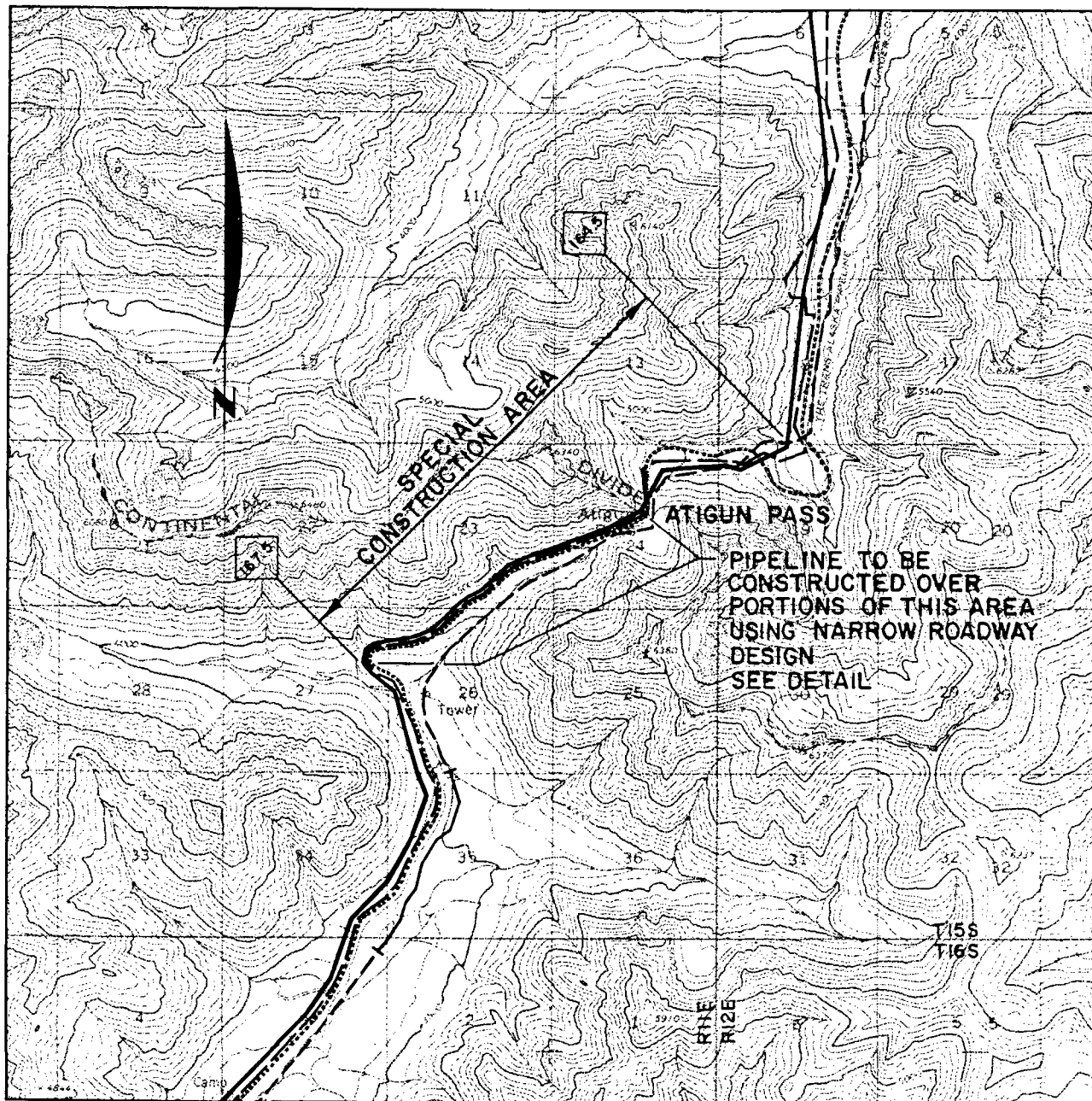
The TAGS pipeline route over Atigun Pass is viewed by Yukon Pacific Corporation (YPC) as a special design area meriting site specific discussion since it is a narrow "pinch point" where up to three pipelines and the Dalton Highway must be accommodated. The Atigun Pass special construction area is discussed in detail in Section 5.2.17.1 of the TAGS Project Description; additional information concerning the Atigun Pass area is provided here to supplement information in the Project Description.

The TAGS pipeline route ascends the upper Atigun River valley on the west side of the Dalton Highway and crosses the TAPS pipeline at the base of Atigun Pass. The route then ascends the north side of Atigun Pass, crossing the

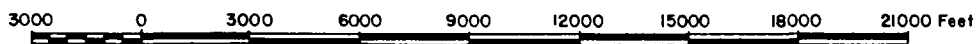
highway (approximately highway Milepost 247.9), TAPS, and the ANGTS right-of-way. The TAGS route then ascends roughly parallel to TAPS to the continental divide, where a second crossing of the highway and the ANGTS right-of-way is made. The TAGS route then descends the south side of the pass proximate to the west side of the ANGTS right-of-way and the highway to the base of the pass. At the base of the south side of Atigun Pass, the route crosses the upper Chandalar River, and parallels the west side of the highway to the Chandalar shelf. The closest proximity to TAPS is at the top of Atigun Pass where TAGS encroaches to within approximately 120 feet of the TAPS pipeline.

An error on Figure 5.23 of the Project Description placing approximately 1000 feet of the TAGS pipeline along the west side of the Dalton Highway on the north side of Atigun Pass has been corrected, as shown on Figure 4.

In the TAGS Project Description, Figure 5.24 (Atigun Pass Construction Area, Narrow Roadway Section) assumed a 30 foot roadway width east of and adjacent to the ANGTS pipeline at the narrow roadway section on the south approach to Atigun Pass. This working width is consistent with roadway conditions in the pass shortly after



SCALE 1:63360



CONTOUR INTERVAL 100 FEET

### LEGEND

- EXISTING DALTON HIGHWAY
- PROPOSED TAGS PIPELINE (B/G)
- EXISTING TAPS PIPELINE (A/G)
- EXISTING TAPS PIPELINE (B/G)
- TRANSITION, TAPS (A/G) TO (B/G)
- PROPOSED ANGTS PIPELINE (B/G)



TAGS MILEPOST



**YUKON PACIFIC CORPORATION  
TRANS-ALASKA GAS SYSTEM**

**ATIGUN PASS  
CONSTRUCTION AREA**

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APPENDIX 9  
**Figure 4**

completion of the TAPS pipeline. Over the years, continued maintenance of the highway has widened the roadway and shifted the roadway ditchline further into the hillside, thus widening the roadway slightly. Figure 5.24 represents the wider roadway conditions which were observed in the summer of 1986.

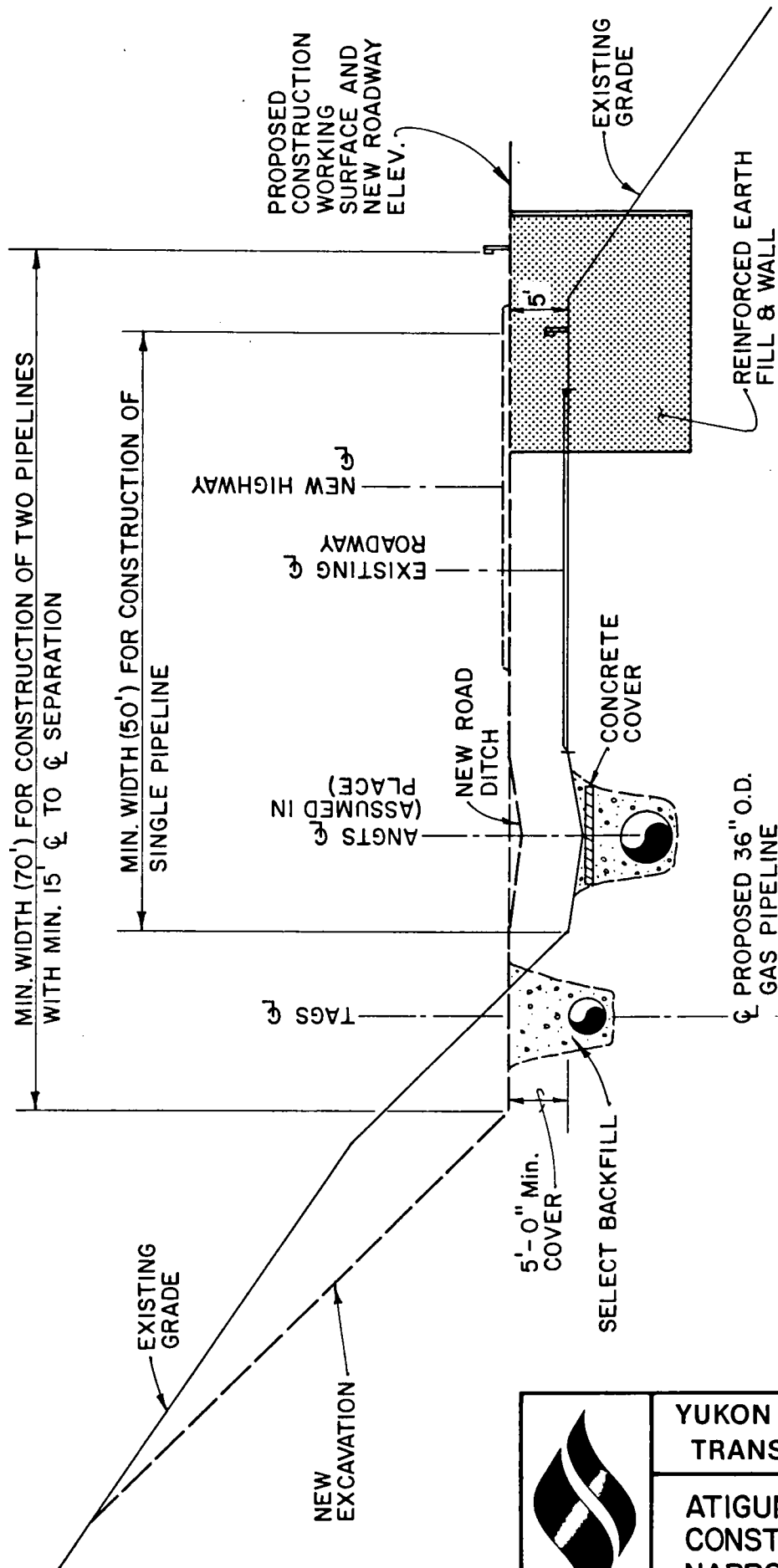
It was assumed that ANGTS had not accounted for the shift in the roadway ditch that has occurred through the years of roadway maintenance. However, maps recently received from the Alaskan Northwest Natural Gas Transportation Company indicate a late change (9-9-85) in routing on the south approach to the Continental Divide. Although the nature of the change is unclear on the map sheets, YPC has assumed that the change in ANGTS alignment takes the current ditch line at the pinch points into account.

YPC has re-evaluated the Atigun Pass special construction area in light of this new information received from the Alaskan Northwest Natural Gas Transportation Company, and has developed a slightly modified plan which allows construction of both pipelines without moving the ANGTS pipeline centerline from its 9-9-85 roadway ditch location.

A reinforced earth fill structure, with wall, will be constructed on the downslope side of the roadway in the two

areas of most severe roadway constriction where additional upslope cutting must be kept to a minimum. These two areas identified by field reconnaissance are located near the top of and about half way down the south side of the pass, and total approximately 6,250 feet in length. The reinforced earth fill base will be constructed to a height of 15.0 feet, thus increasing the roadway width and the roadway elevation by 5.0 feet. A new typical section for the proposed specially reinforced earth fill supported highway is shown in Figure 5. It is based on information obtained during site reconnaissance of the narrowest section of roadway and on recent information concerning the location of the ANGTS pipeline near the top of Atigun Pass. The increase in roadway width created by the reinforced earth fill structure and the increase in roadway elevation will provide most of the additional width required for TAGS pipeline construction and for one future pipeline. A small cut on the uphill side of the roadway will provide the additional width for the minimum separation distance.

The remaining 4,500 feet of roadway will be widened by increasing the uphill cut and downslope fill and raising the roadway elevation. The roadway elevation will be raised to match the added elevation of the reinforced fill-supported sections. The added roadway elevation will



**NOTE**

ANGTS REPRESENTS 48" O.D. GAS PIPELINE  
 PROPOSED BY NORTHWEST ALASKA PIPELINE  
 COMPANY AND ASSUMES CURRENT ROADWAY  
 DITCH IS ANGTS CENTERLINE.

**TYPICAL NARROW ROADWAY CONSTRUCTION**  
**DALTON HIGHWAY-SOUTH APPROACH TO ATIGUN PASS**

Section View Looking North



**YUKON PACIFIC CORPORATION**  
**TRANS-ALASKA GAS SYSTEM**

**ATIGUN PASS**  
**CONSTRUCTION AREA**  
**NARROW ROADWAY SECTION**

**Figure 5**

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feathered" at the top and base of the highway section to prevent any significant increase in current roadway grade.

Detailed design and constuction plans will be coordinated with the state highway department, Alyeska Pipeline Service Company, and the Northwest Alaskan Pipeline Company in order to consider in-place facilities and Rights-of-Way. Design and construction will be accomplished to assure facility compatibilty.

Operations and maintenance of TAGS will also be coordinated with the highway department, Alyeska, and Northwest to assure continued facility compatability through the life of the project. In the event that excavation of the TAGS pipeline is ever required at a location where the two pipelines are spaced relatively close, special techniques will be employed. Hand excavation methods assisted by thawing techniques would most likely be utilized to expose the pipeline after formation of a frost bulb.

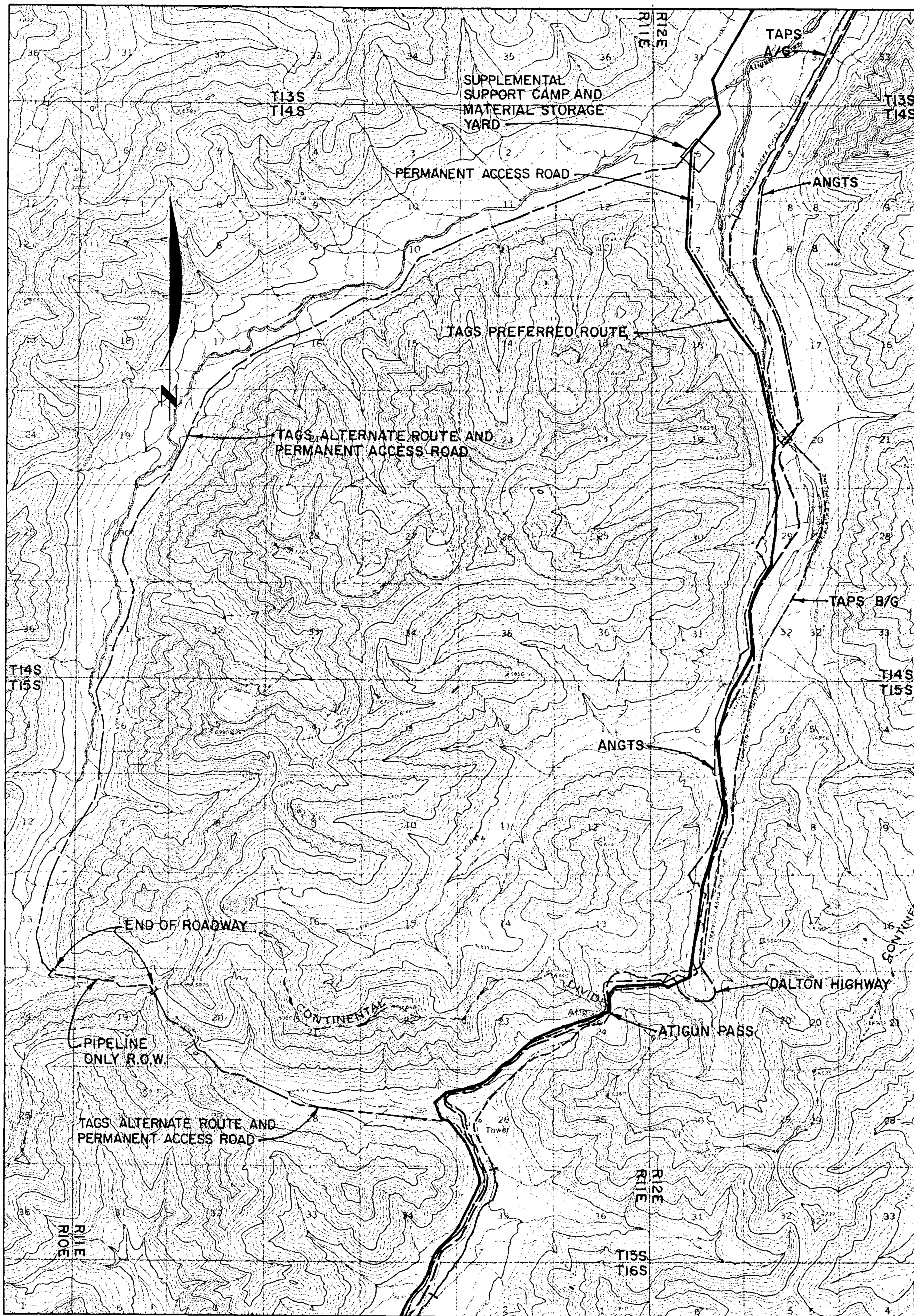
Where pipelines and highway facilities are proximate, precise as-built location data will be necessary. As-built data must be coordinated between companies, and companies should share common survey benchmarks where practical.

7. Identify options considered by YPC for bypassing Atigun Pass and rationale as to why these options were discarded.

The selected TAGS route crosses the Brooks Range continental divide through Atigun Pass, parallel and in some cases proximate to the TAPS and ANGTS Rights-of-Way. An optional routing of the TAGS pipeline through an alternate pass 4.5 miles to the west near the headwaters of the west fork of Atigun River has been evaluated. This optional TAGS route rejoins the existing transportation corridor at the Chandalar River near the south base of Atigun Pass. Figure 6 shows this route alternative at a scale of 1:63,360.

The optional route to the west was eliminated from further consideration for the following reasons:

1. The TAGS preliminary evaluation did not locate a constructable pipeline route on the north approach to the continental divide. The north approach to the pass is blocked by extensive talus slopes and rock glaciers in a steep narrow valley. A conceptual design solution was not apparent, although additional extensive field investigation may suggest a possible route.



**LEGEND**

- EXISTING DALTON HIGHWAY
- PROPOSED TAGS PIPELINE (B/G)
- EXISTING TAPS PIPELINE (B/G)
- EXISTING TAPS PIPELINE (A/G)
- PROPOSED ANGTS PIPELINE (B/G)
- PERMANENT ACCESS ROAD
- ALTERNATE TAGS PIPELINE (B/G)

SCALE 1:63360  
3000 0 3000 6000 9000 12000 Feet



**YUKON PACIFIC CORPORATION  
TRANS-ALASKA GAS SYSTEM**

**TAGS ALTERNATE  
ATIGUN PASS**

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**Figure 6**

2. The optional route is remote from existing infrastructure and does not offer any advantages such as shorter distance, reduced material requirements, improved constructability, or lower construction costs.

3. The optional route has a higher pass elevation and increases pipeline length by 3.5 miles.

4. The optional route requires 21.1 miles of new permanent all weather access roadway. Continued maintenance of the roadway would be required for the life of the TAGS facility.

5. The restricted summer work season, increased pipeline distance, and the new roadway construction will require a supplemental support camp and materials staging area at the confluence of the east and west forks of the Atigun River.

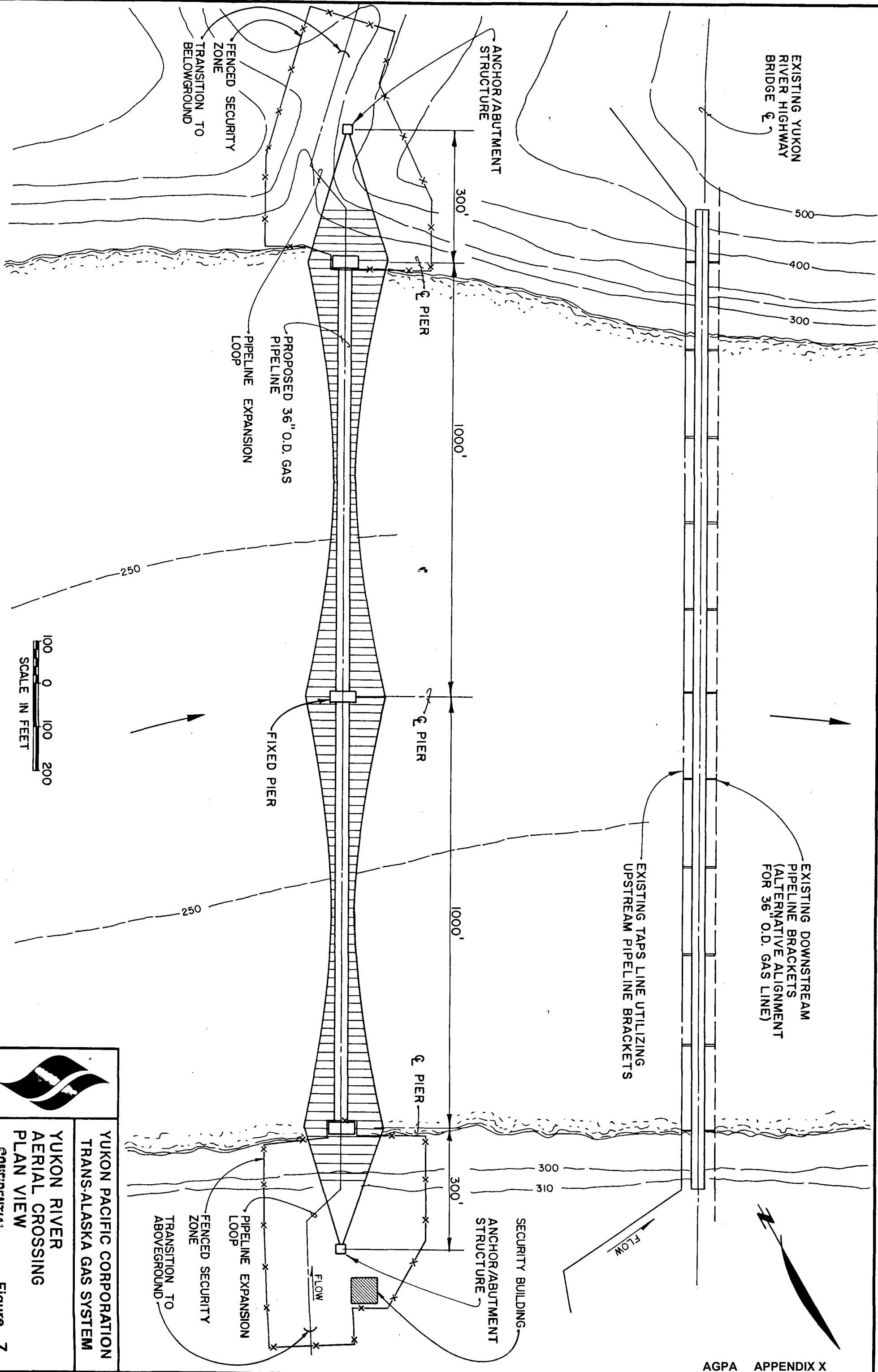
8. Identify TAGS route for Sukakpak Special Construction Area on scale of 1:63,300. Give special attention to proximity to TAPS and ANTGS alignments.


Yukon Pacific Corporation (YPC) is currently considering optional pipeline routes in the area of Sukakpak Mountain. There are a number of factors which the company feels must be considered in the routing of the pipeline in this area,

including: 1) visual quality of the area; 2) constraints related to construction near TAPS or the ANGTS ROW; 3) constraints related to placement of the pipeline within the active floodplain of the Koyokuk River; and 4) the slope of Sukakpak Mountain. YPC will conduct a detailed evaluation of these factors after completion of 1987 summer field investigations. Until these detailed analyses are conducted, YPC cannot provide a complete response to your comment.

9. Identify existing uses that would be curtailed at the proposed TAGS crossing at the Yukon River.

The TAGS aboveground pipeline crossing of the Yukon River would be located approximately 800 feet upstream of the existing Yukon River bridge (Figure 7). The TAGS crossing is located adjacent to an area which is sometimes used for recreational boat access to the river. Access to this existing boat ramp area would be restricted by the security zone for the bridge abutments and for the aboveground pipeline on both bridge approaches. Due to the need to secure the aboveground portion of the pipeline from transition to transition, the security zone for the TAGS Yukon River crossing would be of greater size than the TAPS security zone.





YUKON PACIFIC CORPORATION  
TRANS-ALASKA GAS SYSTEM

YUKON RIVER  
AERIAL CROSSING  
PLAN VIEW

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Figure 7

10. Identify options considered by YPC to avoid dedicated areas of park land, wildlife areas, and historic sites meeting the criteria outlined in the letter of December 1, 1986, from the Coast Guard (Bridges) and specific areas identified by the ADNR on December 18, 1986.

A review of the TAGS pipeline route identified the following four areas of concern:

Quartz Lake State Recreation Area

The TAGS pipeline alignment is routed through the extreme southwest corner of the Quartz Lake State Recreation Area (SRA) for a distance of less than 1000 feet. TAGS is routed through the recreation area to avoid an area of steep cross slopes with fine-grained soils to the south of the SRA boundary. Where the route is within the SRA boundary, the location of the pipeline proximate to the main Quartz Lake access road minimizes new terrain disturbance. Yukon Pacific is considering an optional routing to the south of the SRA boundary which may allow complete avoidance of the area. On-site evaluation of this routing will be required during the summer of 1987 before feasibility can be determined.

### Worthington Glacier State Recreation Area

The TAGS pipeline alignment is routed between the TAPS pipeline and the Richardson Highway, and is located approximately 120 feet west of the roadway shoulder on the highway ROW in an area which does not interfere with the operation of the recreation area. Recent realignment of the Richardson Highway adjacent to the SRA boundary has blocked routing options along Ptarmigan Creek on the east side of the Richardson Highway and SRA boundary. The Worthington Glacier lies to the west of the SRA, blocking any route option to the west of the area.

### Blueberry Lake State Recreation Area

The TAGS pipeline alignment is routed on the old state highway roadbed through Blueberry Lake State Recreation Area in order to minimize clearing and disturbance. Route options to the east of the SRA boundary are precluded by a steep sloped drainage immediately adjacent to the east SRA boundary that leads to Heiden Canyon. An optional route to the west was rejected because of extremely steep slopes and potential soil stability concerns.

11. Identify whether the State comments of January 7, 1987, about crossing the upper Gulkana River relate to the December 5, 1986, amended application or the November 6, 1986, review draft (we note YPC made a significant change in the proposed TAGS alignment between November 6, and December 5, to respond to prior informal State comments).

State comments of January 7, 1987 regarding crossing of the Upper Gulkana River relate to a preliminary crossing located approximately 3/4 mile upstream of the Denali Highway bridge. Based on comments received during a Yukon Pacific Corporation (YPC)/government agency field trip (August 20-21, 1986), the route in this area was revised to obtain an improved river crossing location. During the field trip, the Alaska Department of Fish and Game noted concerns related to construction impact, access, and possible chilled pipe effects.

After the field trip, YPC evaluated alternative alignments in the Upper Gulkana River area, and revised the proposed alignment to improve the river crossing. The relocated Upper Gulkana River crossing is immediately downstream of the Denali Highway bridge. This revised location was selected for improved access conditions, and because confined river flow downstream of the bridge structure serves to minimize the crossing length and disturbed area.

The revised alignment in the area of the Upper Gulkana River is shown on TAGS route maps at a scale of 1:250,000 dated November 1, 1986 (accompanying Draft Project Description) and December 1, 1986 (accompanying Final Project Description). However, the revision was not specifically brought to the attention of Alaska Department of Fish and Game officials until after December 5, 1986.

12. Provide additional details on how proposed TAGS construction activities through Keystone Canyon will not cause significant or complete blockage of important vehicular traffic to and from Valdez over the Richardson Highway. This supplemental information should identify a reasonable worst-case scenario (see State comments of January 7, 1987).

The need for a "careful geological design" during the final design phase of the TAGS pipeline in Keystone Canyon mentioned in the State of Alaska's Department of Transportation and Public Facilities letter of December 11, 1986 was recognized during TAGS routing studies. Yukon Pacific Corporation (YPC) feels this comment applies equally to the remaining TAGS routing throughout the Chugach Mountain area. The successful completion of the new state highway through Keystone Canyon and Thompson Pass

and the of the TAPS pipeline and terminal has provided TAGS with a baseline of data and experience for use in this area.

The predominate rock types in Keystone Canyon are steeply dipping phyllites and graywackes. These rocks are foliated and have a well developed set of joints. The orientation of the canyon parallels one of the major joint systems in the area. Of particular note are the facts that no evidence of rock failures were observed in Keystone Canyon as a result of the 1964 Alaska Earthquake and the excellent record of highway performance.

YPC, however, is concerned about the potential for creating localized unstable rock slopes by the undercutting or daylighting of discontinuities in the bedrock during construction of the pipeline. The failure of a locally undercut or day- lighted bedrock section could create additional traffic delays and increased requirements for rock reinforcement. Since construction through the canyon will be limited to very short (200 to 400 foot sections) the extent of a potential problem area and its potential impact is also limited to a relatively short and manageable length.

To minimize the potential problems which could develop during construction, the detailed design phase will be preceeded by a detailed field investigation and evaluation. The detailed investigations required for setting the final pipeline centerline through Keystone Canyon will be coordinated closely with the state highway right-of-way. These investigations will include detailed geologic mapping, core and soil borings and testing, groundwater investigations, surface water hydrology, and rock slope stability evaluations.

The detailed design and construction plan for TAGS will be based on the results of the field investigation and evaluation, and will be coordinated with the Alaska Department of Transportation and Public Facilities during the final design phase. Coordination of blasting and excavation procedures, rock reinforcement requirements, traffic control, and safety are considered to be a necessary part of a successful design by YPC.

13. Clarify whether crossing of Solomon Creek (p. 5-32 and elsewhere) is an aboveground or below ground crossing.

The Solomon Creek Crossing is an aboveground crossing. The pipeline will be buried on both sides of the creek, but due

to the deeply-incised nature of Solomon Creek in the area, the pipeline crossing will be designed as a freespan for that portion which is over the creek.

14. Provide on air [sic] quality information and analysis used by YPC to determine if Anderson Bay meets safety standards for LNG facility siting (49 CFR 193).

Analysis of dispersion exclusion zones is discussed in Attachment 3.

15. January 7, 1987, comments from the State indicate there may be acquisition requirements on air quality for a minimum of one year prior to the State considering issuance of air quality permits. Will this be accomplished within the time frames for initiation of construction of the LNG/marine terminal facilities shown in the December 5, 1986, amended TAGS application?

Yukon Pacific Corporation (YPC) is aware of the air quality monitoring requirements of ADEC. A monitoring program can be accomplished within the currently projected project time frames.

16. Evaluate and provide appropriate response to LNG terminal siting factors outlined in the DOT/OPS letter of December 19, 1986. Specifically, will more area at the terminal be required should smaller tanks be used?

See Attachment 3.

17. Provide routing of TAGS alignment around TAPS terminal, taking into account issues raised in the letter of November 23, 1986, by Alyeska Pipeline Service Company (APSC). The proposed alignment at a scale of 1:63,360 also should include an initial evaluation of this proposed TAGS routing from APSC.

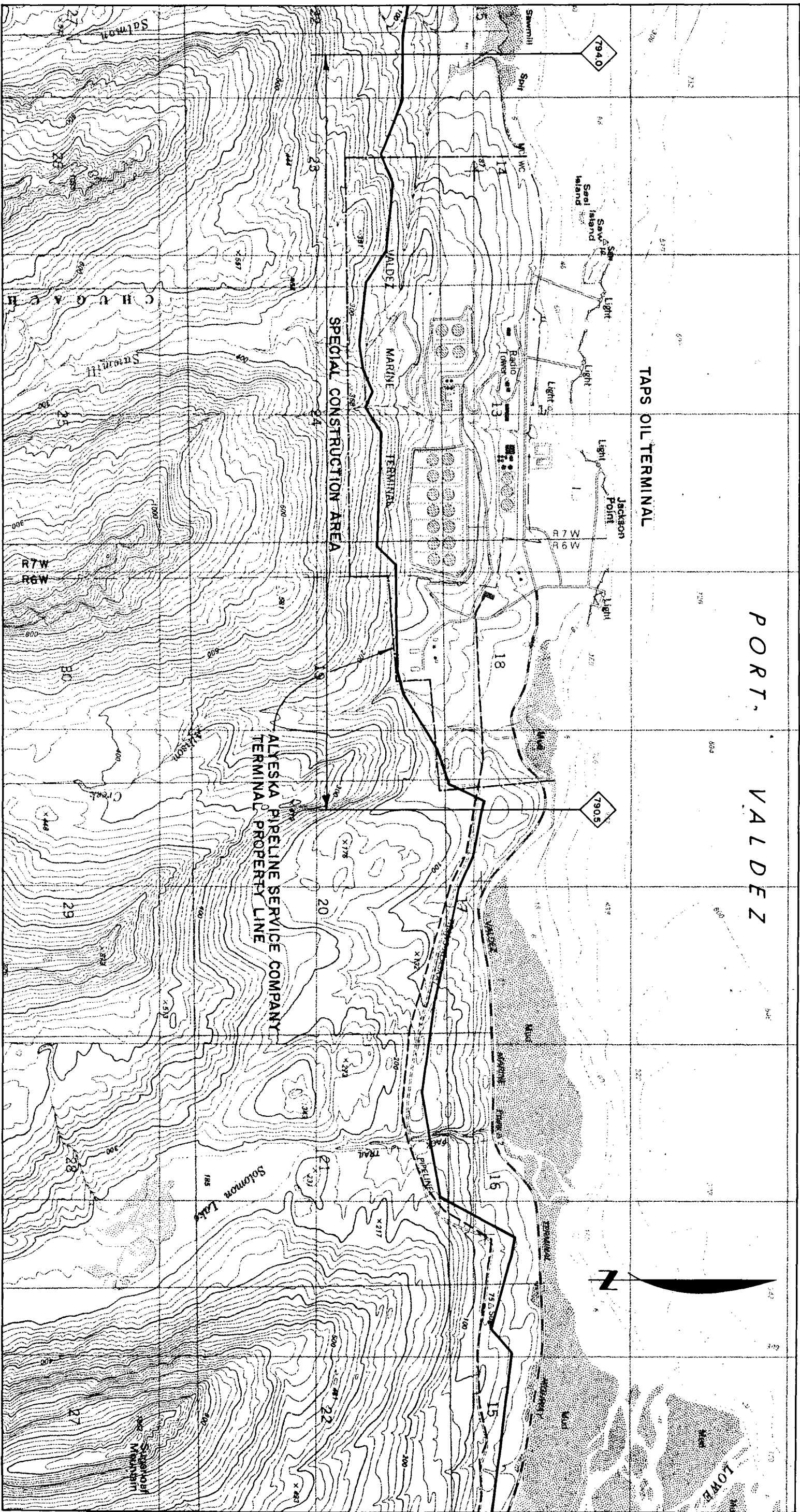
The TAGS alignment along the south side of Port Valdez will require a routing south of the TAPS Oil Terminal Site. This pipeline segment is considered as a special construction area due to the proximity of the pipeline to TAPS facilities. The total length of this special construction section is approximately 18,500 feet.

The feasibility of preliminary routing alternatives in the area of the TAPS terminal site has been evaluated. A proposed route for the TAGS pipeline has been identified between the Fort Liscum Area (M.P. 790.5) and the mouth of Sawmill Creek (M.P. 794.0). Further route evaluation and

alignment design in this area will involve coordination with the Alyeska Pipeline Service Company. Selection of a specific route location in the area of the terminal will be the result of detailed evaluation of available alternatives, design requirements, and construction procedures. Proposed TAGS operating and maintenance requirements will also affect specific route selection.

Figure 8 shows the proposed TAGS route between the Fort Liscum area and the mouth of Sawmill Creek based on initial feasibility evaluations. The TAGS alignment crosses a belowground TAPS section at approximately milepost 790.5 to provide a routing south of all TAPS terminal facilities. The TAGS pipeline route generally maintains a horizontal separation greater than 1,000 feet from facilities at the TAPS terminal.

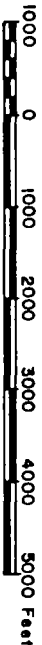
Soil conditions to the south of the TAPS oil terminal are expected to be predominately glacial till over bedrock. Local areas on glacially eroded terraces are expected to have thick organic cover over the glacial tills. After workpad grading is completed, however, it is expected that the TAGS pipeline will be buried in bedrock over most of its length. A warm gas pipeline operating mode is planned for this area.



LEGEND

- PROPOSED TAGS PIPELINE (BELOW GROUND)
- EXISTING TAGS PIPELINE (BELOW GROUND)
- PROPERTY LINE
- TAGS MILEPOST

SCALE 1:25,000



CONTOUR INTERVAL 20 METERS



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TAPS OIL TERMINAL  
CONSTRUCTION AREA

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Figure 8

The construction of the TAGS pipeline around the TAPS terminal is estimated to require two summers of work. Civil work related to the clearing and grading of the right-of-way will be completed during the first summer in preparation for pipeline installation during the second summer. Care will be taken from the onset of construction to avoid the diversion of natural surface drainage which could affect existing drainage controls on the TAPS terminal site. Temporary, and where possible, permanent erosion control measures will be established during the first summer working season.

Preparatory work during the first summer season on this segment will begin in the Allison Creek area and proceed to the west.

Construction of the workpad and preparation of the right-of-way will be restricted to daylight operations when work is upslope of TAPS facilities. Clearing and grubbing of the right-of-way will be followed by cut and fill construction of the workpad/construction zone.

Pipeline construction in the second summer will proceed from east to west through this area with a typical construction spread. Precautions and restrictions will be similar to those for the civil construction.

Detailed design and construction plans for this segment will be coordinated with the Alyeska Pipeline Service Company during the final design phase and before start of construction activities. Coordination between the two companies will continue throughout construction.

During operation of TAGS, the construction workpad through this segment will be utilized only for monitoring and maintenance activities, and will not be used for permanent access to the LNG Plant/Marine Terminal.

18. Identify the extent, if any, waste heat generated by the Anderson Bay LNG facility might create fog sufficient to restrict existing air access to/or from Valdez airport.

This question has been summarized and addressed by Harding Lawson Associates in the first draft of the environmental consequences section of the EIS. Please refer to Section 4.3.2.

19. Indicate when YPC will prepare Spill Prevention Control and Countermeasure (SPCC) plans for all construction and permanent sites where fuel will be stored in quantities in excess of 10,000 barrels (see State comments of January 7, 1987).

YPC will prepare Spill Prevention Control and Counter-measure (SPCC) plans during the detailed design stage of the TAGS project. Planning for prevention and control of spills has been considered during the conceptual definition of the facilities. Each facility requiring liquid fuels or hazardous substance storage has been identified. Response No. 21 of this document identifies where significant quantities of fuel or hazardous substances will be stored, handled and transported at TAGS facilities.

YPC will construct and maintain impermeable dikes and other suitable structures around all temporary and permanent storage facilities for fuel and other hazardous substances. All waste oil products generated during project construction and operation will be routinely collected and disposed of at the nearest approved facility.

20. Describe the types and frequency of anticipated noise levels associated with permanent facilities, especially compressor stations (5 and 10-unit configurations) and LNG terminal.

Facility noise levels depend on several factors related to equipment selection, arrangement, orientation, enclosure and operating conditions. In addition, such environmental factors as ambient conditions and background noise significantly affect noise attenuation. During detailed project

design stages, noise levels, frequencies, and attenuation characteristics will be specifically evaluated for each facility site.

At each major TAGS facility location, turbine driven compressor units and/or generator units are the significant contributors to noise generation. For purposes of simplification, noise levels have been obtained for a single assumed equipment type that could be used for turbine/compressor service at compressor stations, or for turbine/compressor or turbine/generator service at the LNG plant, based on TAGS conceptual definition. The following noise levels were provided by the manufacturer of the assumed equipment type as follows:

90 dBA @ 3'	distance from source
59 dBA @ 400'	distance from source

These noise levels are for "bare" operating units without enclosures, silencing equipment, or other features to reduce noise.

A ten compressor station configuration, utilizing a single turbine/compressor unit for gas compression, will produce expected noise levels less than 59 dBA at a distance of 400' from the equipment. TAGS turbine/compressor units will be fully enclosed and are planned to have exhaust silencers, further contributing to noise reduction.

A five compressor station configuration, utilizing two turbine/compressor units for gas compression, will produce estimated noise levels less than 62 dBA at a distance of 400' from the equipment. These stations would also be fully enclosed and are planned to have exhaust silencer equipment.

Generally, if the distance between a point noise source and a receptor in the far field is doubled, the sound level will decrease by 6 dB's. Applying this generalization for rough estimating purposes, sound levels are expected to be below background noise levels at a distance of 3000 to 4000 feet from any station location. Outdoor ambient noise levels less than 40 to 45 dBA are extremely unusual, but have been assumed as the minimum background noise levels for the TAGS project.

The TAGS LNG plant facility involves a complex arrangement of turbine driven compressor units within process trains. Utilizing the assumed equipment type, 25 turbine/compressor units would be required to meet liquefaction plant conceptual design parameters. In addition, 4 turbine/generator units would be required. Considering that each unit will be fully enclosed and that plant layout characteristics will reduce noise levels, it is estimated that

overall plant noise levels will be less than background noise at distances less than 15,000 feet from the plant.

21. Estimate approximate quantities and types of waste to be generated at compressor stations, LNG plant/marine terminal, and construction camps. As appropriate, identify the general volume and types of wastes reasonably anticipated to result from construction of the TAGS project. Specifically identify hazardous wastes and materials.

Three major categories of wastes will be generated at compressor stations, the LNG plant/marine terminal, and construction camps: 1) wastewater; 2) solid waste; and 3) hazardous materials.

Wastewaters generated from these facilities generally include:

- domestic wastewater
- water treatment plant filter backwash
- vehicle and equipment washdown
- sludge from wastewater treatment plants
- stormwater runoff
- industrial wastewater

Domestic wastewater generated at construction camps will be treated by package plant systems designed to comply with the State's established water quality criteria as well as

specific waste limits specified in the State wastewater disposal regulations. The plants will also be sized to accommodate periodic delivery of wastes from field toilets. Average daily wastewater flows from each camp are listed in Table 2. These flows were estimated on the basis of a use rate of 10 gallons per capita per day (gpcd).

Sewerage sludge will be lime stabilized, dried and land-filled or dewatered and incinerated on site. Quantities of sludge will be determined by the treatment process used. The quantity of water treatment plant backwash is dependent on the characteristics of the local water source and on the final design of treatment facilities. Backwash will be combined with effluent from wastewater treatment plants or discharged to the gravel pad a sufficient distance from water courses.

Quantities of surface runoff from each pad are dependent on quantities of local precipitation and site-specific design, and will be estimated as part of detailed design. Retention facilities will be used as required to reduce quantities of sediment in runoff.

Flows from vehicle and equipment washdown at construction camps are estimated at 10-15% of the total daily wastewater generated. After collection and grease and oil separation,

vehicle and equipment washdown will be routed through a settling basin.

Domestic wastewaters generated during operation of compressor stations will either be treated by package plant systems, or be collected by a vacuum system and stored in on-site tanks for offsite treatment and disposal. The resident operational staff at a compressor station is 10 persons with accommodations for up to 20 additional maintenance personnel. Using a per capita rate of 100 gpcd, the average daily quantity of wastewater generated would be 1,000 gallons with a maximum of 3,000 gallons. Small quantities of industrial wastewaters will also be generated at compressor stations. Underfloor or similarly placed sumps will collect solvents, lube oils, and other substances. Sumps will be emptied periodically and wastewater disposed of at an approved location. Vehicle washdown and surface runoff management will be similar to that at construction camps.

Wastewater generated during operation of the LNG plant-marine terminal is discussed in Section 10.1.2 of the Project Description.

The estimated quantity of solid wastes generated at construction camps was determined on a per capita basis, using a rate of 7.9 lbs/person/day. The typical percentage

physical composition of these wastes is estimated as follows:

- 20-30%    Municipal-type wastes (paper, cardboard, food and beverage cans, bottles, etc.)
- 5-10%    Foodscraps & cooking wastes
- 50-60%    Garage, warehousing and repair wastes (equipment repair metals, pallets, strapping, form lumber, etc.)

Estimated quantities of solid waste generated at each camp are listed in Table 2. Solid wastes generated at each camp will be landfilled if local site conditions permit, or hauled to another approved location.

Solid wastes generated at compressor stations should range from approximately 50 to 150 pounds/day. These wastes will be managed the same as construction camp wastes. Wastes from operation of the LNG plant/marine terminal should average approximately 500 pounds/day, and will be disposed of at a properly developed and approved landfill on-site, or at local solid waste management facilities.

Table 2  
Construction Camp Waste Quantities

<u>Mile post</u>	<u>Camp</u>	<u>Bed Spaces</u>	<u>Average Daily Wastewater Quantities (gpd)</u>	<u>Average Daily Solid Waste Quantities (lbs)</u>
0	Prudhoe Bay	200	20,000	1,580
43	Fanklin Bluffs	400	40,000	3,160
66	Comp. Sta. #1	400	40,000	3,160
84	Happy Valley	500	50,000	3,950
125	Comp. Sta. #2	400	40,000	3,160
140	Galbraith Lake	500	50,000	3,950
170	Chandalar	500	50,000	3,950
201	Dietrich	600	60,000	4,740
213	Comp. Sta. #3	400	40,000	3,160
236	Coldfoot	900	90,000	7,110
281	Comp. Sta. #4	400	40,000	3,160
299	Oldman	700	70,000	5,530
345	Five Mile	700	70,000	5,530
358	Comp. Sta. #5	400	40,000	3,160
394	Livengood	700	70,000	5,530
422	Comp. Sta. #6	400	40,000	3,160
451	Fairbanks	1,000	100,000	7,900
487	Comp. Sta. #7	400	40,000	3,160
526	Delta	800	80,000	6,320
563	Comp. Sta. #8	400	40,000	3,160
600	Isabel pass	600	60,000	4,740
639	Comp. Sta. #9/ Sourdough Creek	900	90,000	7,110
682	Glenallen	700	70,000	5,530
721	Comp. Sta. #10/ Tonsina	1,000	100,000	7,900
770	Sheep Creek	500	50,000	3,950
797	LNG Plant/ Marine Terminal	1,700	170,000	13,430

Hazardous substances to be stored, handled, and consumed at the TAGS compressor station sites include the following in significant quantities:

<u>Hazardous Substance Description</u>	<u>Monthly Consumption</u>	<u>Storage</u>	<u>Remarks</u>
Nitrogen	3,750 SCF	7,500 SCF	250 standard cubic foot (SCF) bottles at 2200 psig, 6 bottles/station
Gas Turbine/ Compressor Oil	0	1,200 gal	Synthetic Oil
Seal Oil	550 gal	5,500 gal	Stored in 55 gallon drums
Halon (or other inertgas)	0	3,000 lbs	Stored in 300 lb. cylinders
Glycol	20	2,200 gal	Stored in 55 gal drums
Freon (or other refrigerant gas)	0	10,000 lbs	Stored in one ton containers. Make-up storage of 2%
Diesel	11,500 gal	200,000 gal	40,000 gal tank at station
Gasoline	3,000 gal	25,000 gal	5,000 gal tank at station

The Fairbanks Maintenance Facility will maintain storage of the following refrigerants and chemicals:

Lube Oil	8,600 gal (two reservoir replacements)
Seal Oil	1,200 gal
Halon	8,800 lbs (one total system replacement)
Freon	18,000 lbs (5% volume/year)

Hazardous substances to be stored, handled, and consumed at the TAGS LNG plant/marine terminal site include the following significant quantities:

<u>Description</u>	<u>Monthly Consumption</u>	<u>Storage</u>	<u>Remarks</u>
Ethylene	55,440 lbs	1,200,000 lbs	6,000 bbl refrigerated storage sphere.
Propane	484,440 lbs	4,532,000 lbs	4 high pressure 16,230 ft <sup>3</sup> bullets.
Nitrogen	684,000 SCF	5,121,050 SCF	55,000 gal liquid nitrogen tank.
Gas Turbine/ Compressor Oil	nil	150 bbl	Stored in 55 gal drums.
Seal Oil	25 bbl	50 bbl	Stored in 55 gal drums.
Glycol	2 bbl	80 bbl	Stored in 55 gal drums.
Chlorine	350 lbs	2,000 lbs	Stored in 2000 lbs cylinders.
Halon (or other inert gas)	0	3,000 lbs	Stored in 300 lbs cylinders. (One system replacement)
Methanol	0	10 bbl	Stored in 55 gallon drums.
Diesel	1,845 bbl	40,000 bbl	Two 20,000 barrel tanks.
Molecular Sieve	0	10,000 lbs	Stored in barrels. (One trap replacement)
Activated Carbon	0	10,000 lbs	Stored in barrels. (One trap replacement)

Other hazardous materials to be stored, handled, and used at TAGS permanent facility locations include various cleansers, oils, lubricants, electrical materials, corrosion inhibitors, acids, paints, pesticides, solvents,

glycols, water treatment chemicals and reproduction equipment chemicals.

Disposal of hazardous substances will be in accordance with existing applicable State and Federal regulations. Any special permits required for transportation of hazardous substances will be obtained from proper authorities.

22. Is 100 percent weld inspection still planned and, if not, what standard will be used?

TAGS pipeline welds will be nondestructively tested in accordance with U.S. Department of Transportation Pipeline Safety Regulations, 49 CFR 192. As required by 49 CFR 192.243, the following percentages of each day's field butt welds will be nondestructively tested over their entire circumference:

- (1) In class 1 locations, at least 10 percent
- (2) In class 2 locations, at least 15 percent
- (3) In class 3 and 4 locations, and at crossings of major rivers, 100 percent if practicable, but not less than 90 percent
- (4) Within public highway rights-of-way including tunnels, bridges and overhead road crossings, and at pipeline tie-ins, 100 percent.

The acceptability of a weld that is nondestructively tested or visually inspected will be determined according to the standards in Section 6 of API (American Petroleum Institute) Standard 1104.

23. Provide a summary of termination procedures to be considered at the conclusion of the TAGS project. These should include pipeline and related use areas, compressor stations, and LNG plant/marine terminal.

Yukon Pacific Corporation (YPC) has not yet determined the specific termination procedures which will be employed at the conclusion of the project. A full review of these procedures will be submitted during the "authorization to proceed with construction" phase of the project. It is assumed that YPC will have to obtain the approval for these procedures from those agencies which have jurisdiction over the project before construction can begin.

24. What is meant by the term, "intitial evaluation" on the first line of the last paragraph on page 7-3 and elsewhere in chapter 7?

"Initial evaluation" refers to those initial field investigations that will be conducted during project definitive

design stages. However, it should be noted that the potential for liquefaction has been considered in Yukon Pacific Corporation's routing studies to date.

25. Clarify the intent of culvert design on page 9-4. Are design criteria intended to prevent outflow erosion and not impede fish movement?

This section was misworded. Yukon Pacific Corporation does not intend to impede fish movement and does plan to prevent outflow erosion.

26. Expand discussion of ballast water disposal methods associated with LNG tankers where ballast water intake may be from polluted waters and discharged in the waters of Prince William Sound.

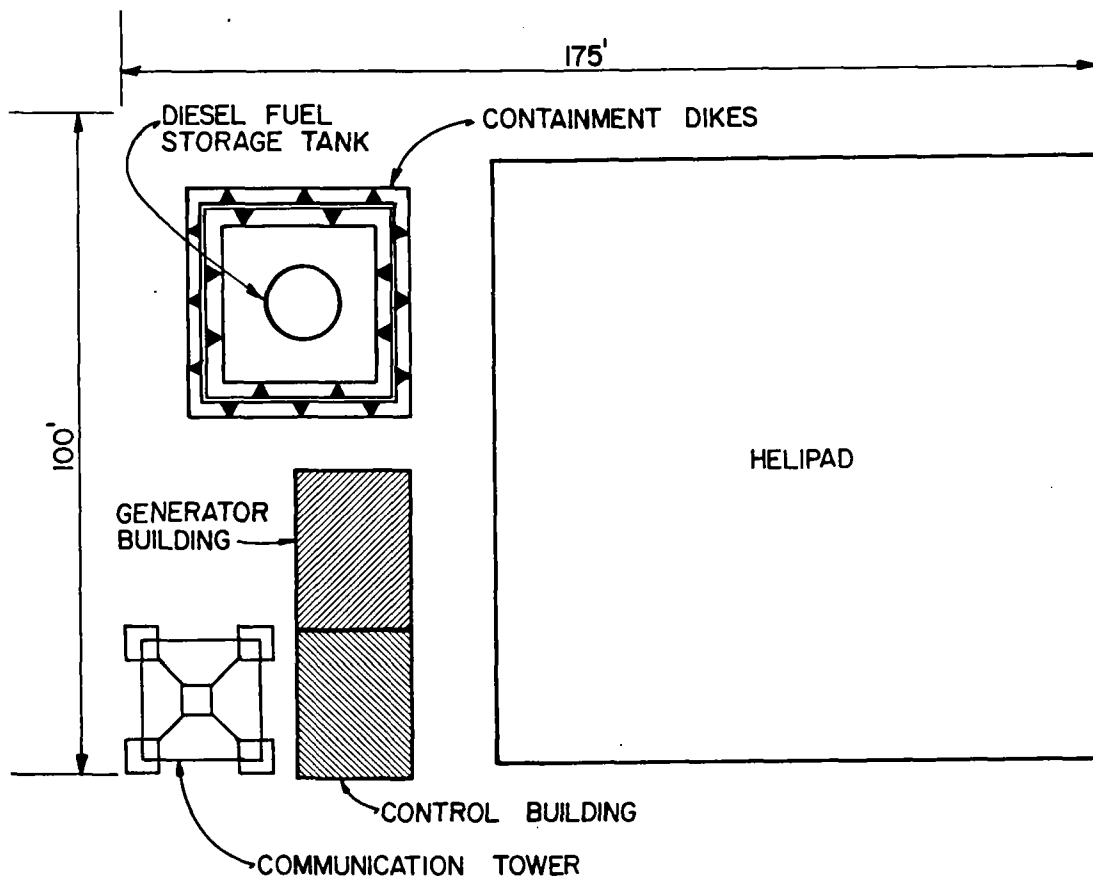
Typical 125,000 m<sup>3</sup> capacity LNG tankers require approximately 66,000 tons of ballast under normal operating conditions. Sea water is used to provide such ballast. Ballast water may occasionally be taken on in areas with poor water quality such as Tokyo harbor. It will be the company's policy that ballast water taken on in areas with polluted water will be disposed of at open sea and replaced

with clean sea water. Polluted ballast water will not be disposed of in Prince William Sound.

27. Identify where the TAGS project intends to place communication facilities and the extent, if any, TAGS facilities would use existing sites (see page 3-5).  
Describe a typical communication site.

It is YPC's understanding that approval for specific communication facility sites cannot be received until Stage II of the Project. Therefore, the specific number and locations of these facilities has not yet been determined.

Figure 9 shows a plan view of a typical off-plot communications facility (conceptual) for the TAGS project. Where microwave communications technology is utilized, off-plot communications facilities will be required to fill line-of-sight gaps between TAGS compressor station sites and communication facilities existing within the transportation and utility corridor. Each site for off-plot communication facilities will require approximately 0.6 acres of land. During Stage II of the project, communications technology alternatives will be evaluated, specific communications system design will be developed, and the number and location of any sites



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TRANS-ALASKA GAS SYSTEM

TYPICAL REMOTE  
COMMUNICATION  
FACILITY

Figure 9

required in addition to those existing within the corridor will be determined. It is the intent of YPC to maximize use of existing facilities (towers, etc.) within the corridor.

28. Provide an analysis of scoping concerns on the proposed TAGS alignment, access and facility placement relative to the Salcha River.

During the Scoping meetings and in subsequent meetings held with the Salcha River group, the following major points were identified. Yukon Pacific Corporation's (YPC) responses are listed beneath each point.

1) No additional overland access.

YPC does not intend to construct new overland access in the Salcha River area, other than the pipeline construction workpad.

2) Construction access along the existing pipeline corridor.

Construction access to the TAGS pipeline will be from existing transportation corridors.

3) Locate the project within the existing ROW.

The TAGS project will be generally within the same corridor as TAPS. However, for safety reasons the gas pipeline will not be constructed on the same work pad as TAPS, and YPC will generally maintain 500-600 feet of separation between the pipelines in the Salcha River area.

4) Locate the compressor station out of sight and sound of the Salcha River valley.

Currently, YPC has located a compressor station on the ridge at the northern edge of the valley. This site was selected because of the general geologic characteristics for building foundations, the fact that it would be located generally out of the Salcha River valley, and because of engineering constraints related to the compression of the gas. At the scoping meeting the group expressed concern as to the location of the compressor station and wanted to know if any modifications could be made. YPC stated that the site would be evaluated to determine if any modifications were possible. It was also noted that the final location

of the compressor station would be determined in the final design stage of the project. This detailed design effort is not scheduled to begin until after the grant of Right-of-Way from the State of Alaska.

As stated at the meeting, YPC will contact the Salcha River group early this summer to review the compressor station siting question in the field.

5) No discharge of cooling water into the Salcha River.

Since YPC does not intend to use water for temperature reduction in the compressor stations, no cooling water will be discharged into the Salcha River.

6) No additional gravel pit development within the Salcha River valley.

At this time YPC has not determined the specific material site locations along the pipeline ROW. However, we are aware of the concerns expressed by the Salcha River group on this subject.

29. Clarify acreages to be disturbed by the TAGS project; e.g., page 5-115 says an average of 30 acres per compressor station, yet a figure of 278 acres is used rather than 300 (10 x 30 = 300).

Yukon Pacific Corporation (YPC) estimates that 278 acres will be disturbed for the ten compressor station design. The reference to an "average of 30 acres" on page 5-115 of the TAGS Project Description is incorrect. The statement actually reads "approximately 30 acres each." The estimated disturbed area for each compressor station is:

<u>Compressor Station</u>	<u>Estimated acreages To be Disturbed</u>
1	40
2	30
3	30
4	30
5	30
6	30
7	30
8	30
9	14
10	<u>14</u>
Total	278

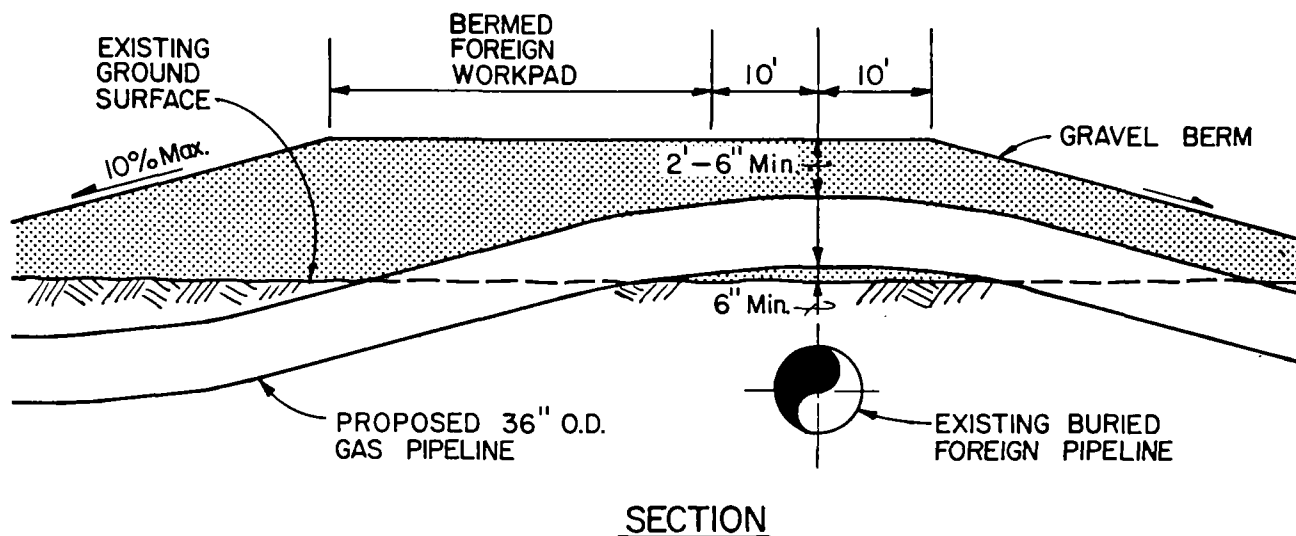
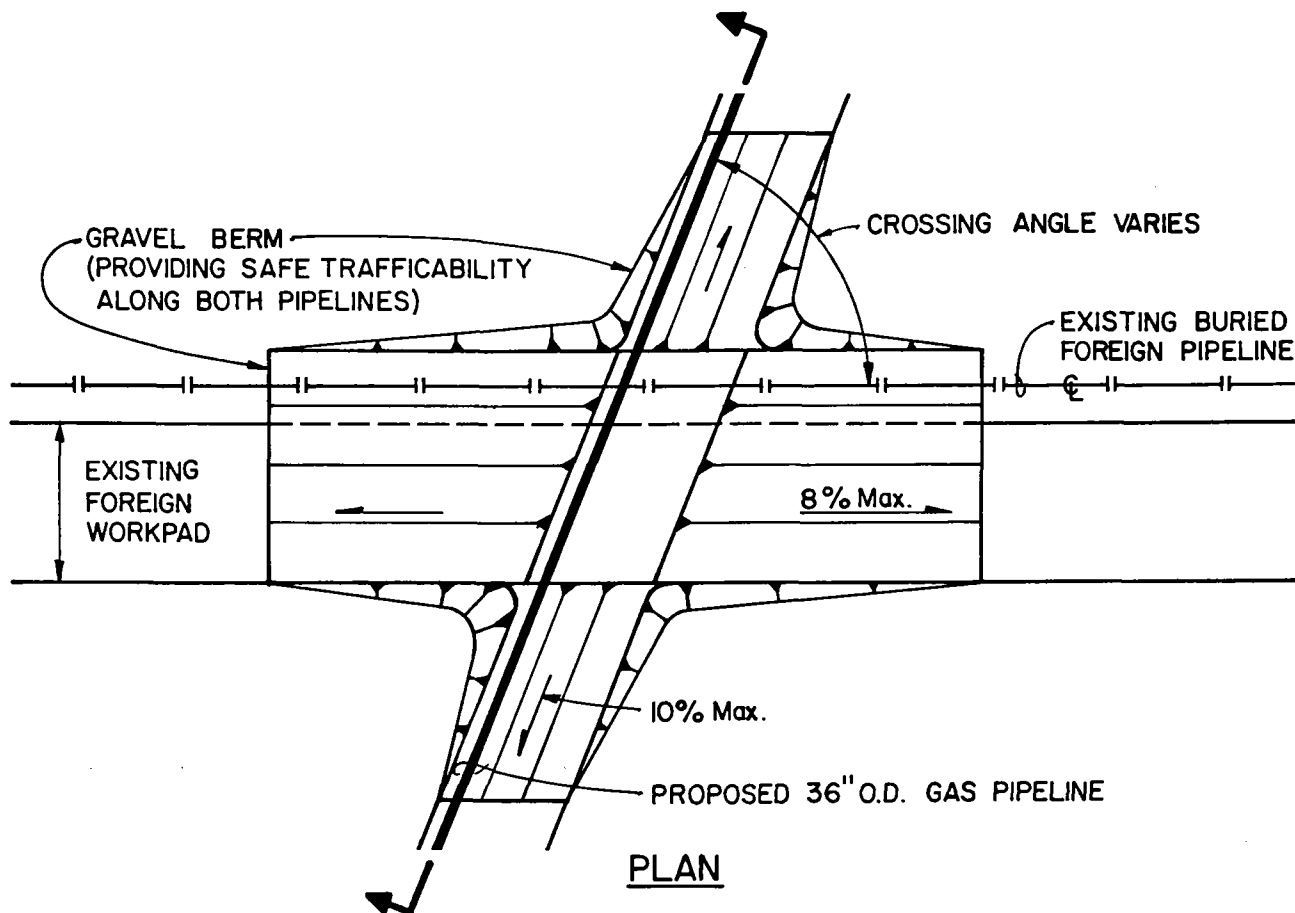
The estimated acreage for Compressor Station 1 is slightly larger (40 acres) to account for pipeline Construction Spread 1 materials storage requirements at Prudhoe Bay. The estimated acreages for Compressor Stations 9 and 10 are

lower (14 acres each) due to planned joint use with pipeline construction camps at Sourdough Creek and Tonsina (see page 5-116 of the TAGS Project Description).

30. Clarify how the TAGS proposed typical crossing of foreign buried pipelines will accomodate access needs along those foreign pipelines by their respective operators. The typical drawing on page 5-86 shows a configuration that will not accommodate large vehicular traffic along the foreign pipeline.

Figure 5-12 of the Project Description showing a typical TAGS crossing of a buried foreign pipeline has been revised, and is shown as Figure 10. The revised scheme will accommodate large vehicular traffic along the foreign pipeline as well as along the TAGS pipeline.

In order to provide permanent access through the TAGS foreign pipeline crossing points, ramped gravel berms will be constructed. Existing foreign pipeline workpads will be ramped over the TAGS pipeline at grades of 8 percent or less. The ramped foreign pipeline workpad will be constructed so that the existing workpad width is not reduced. Placement and compaction of gravel material will be accomplished as required to provide a permanently serviceable structure. Each crossing location will require



## NOTES

1. TYPICAL FOR CROSSING OF  
EXISTING TAPS OR PROPOSED ANGTS  
BELOWGROUND PIPELINES.
2. SITE SPECIFIC DESIGNS MAY BE  
REQUIRED TO FACILITATE SURFACE  
DRAINAGE.



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TYPICAL CROSSING OF  
BURIED FOREIGN PIPELINE  
(TAGS BERMED ABOVE)

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Figure 10

site specific evaluation of geotechnical and hydrological conditions for design. It will be necessary to coordinate design, including specific location, construction, and long term maintenance efforts with existing foreign pipeline operators.

31. Describe how a typical block valve works and support facilities, such as electrical supply.

Each mainline block valve will have an enclosure adjacent to the valve for housing instrumentation and telecommunications equipment. These valve control enclosures will have heating and ventilation equipment, lighting, batteries, and a power generator. The generator will be fueled by pipeline gas. At each valve, a micro-processor will collect data from instrumentation and coordinate the transmitting and receiving of signals from the Operation Control Center. Valve status (open or closed), pressure, and temperature data are collected and transmitted. Communication of data will require a small, mobile antenna to access the main telecommunication system. All facilities will be contained within the fenced area (50' x 50') shown in Figure 5.22 of the Project Description.

Mainline block valve actuators will operate utilizing pipeline gas pressure as the primary source of power. Designed to operate in a "fail-safe" mode, the actuators will close a block valve as result of pipeline gas pressure loss. Each actuator will have an auxiliary supply of pipeline gas under pressure that is sufficient to power the block valve into a closed position in the absence of pipeline gas at sufficient pressure to operate the valve.

32. Respond to the comments of the Coast Guard dated January 2, 1987, on the requirement for a waste reception facility to handle oily ballast water and bilge slops. Take into consideration use of the LNG terminal by tugs and other shipping that reasonably can be expected to produce oily wastes.

Yukon Pacific Corporation (YPC) has already taken into account the treatment of oily wastewater in Figure 10.1 (LNG Plant Water Supply and Wastewater Systems) of the Project Description. In general, YPC does not anticipate significant amounts of oily ballast water from LNG tankers due to the nature of the LNG containment vessels within the tanks. Other ships or tugs which would contain oily waste would be required to use the marine terminal wastewater system. YPC believes that the water quality effects to Port Valdez will not exceed EPA and State Water Quality Standards.

ATTACHMENT 2

Air Quality Impact Screening Analysis

Yukon Pacific Corporation

Gas Conditioning Facility

Prudhoe Bay Unit

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Air Quality Impact Screening Analysis  
Yukon Pacific Corporation  
Gas Conditioning Facility  
Prudhoe Bay Unit

Dames & Moore  
January 1987

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103.0/4-COV

## 1.0 INTRODUCTION

This technical note will present the results of a screening analysis to determine the potential air quality impacts of a Gas Conditioning Plant (GCF) to be located at Drill Site No. 7 within the Prudhoe Bay Unit (PBU). Previous modeling studies conducted for similar sources within the PBU have indicated that the PSD increment levels and Alaskan Ambient Air Quality Standards (AAAQS) would be maintained (e.g., Dames & Moore 1978, Radian 1982, Radian 1983). While these studies considered all the primary pollutants, the primary pollutant of concern was found to be nitrogen dioxide ( $\text{NO}_2$ ). The purpose of the present analysis was to determine the potential annual  $\text{NO}_2$  impacts associated with the GCF based on preliminary design information and conservative dispersion modeling assumptions.

## 2.0 EMISSIONS ESTIMATES

Annual nitrogen oxide ( $\text{NO}_x$ ) emission rates and stack parameters were estimated using a conservative set of criteria in lieu of specific design information concerning the GCF.  $\text{NO}_x$  emissions were calculated for the sources at the GCF based on rated break horsepower, natural gas heating value (where applicable), and applicable emission factors. The emission rates and stack parameters used in the dispersion modeling analysis are shown in Table 1.

The natural gas-fired turbine emission calculations conservatively assumed the lower heating value provided in previous studies involving the Alaska Gas Conditioning Facility (AGCF) (Table B-1, Radian 1982). The emission factor for the gas-fired turbines was derived based on mass balance, assuming the same turbine gas composition as for the AGCF and an emission limit of 100 ppmv  $\text{NO}_x$  at 15 percent oxygen on a dry basis. The calculated emission factor was then 202 lb  $\text{NO}_x$ /MMSCF. The turbines were assumed to operate at full load, all year.

The glycol heater  $\text{NO}_x$  emissions were based on an emission limit of 0.08 lb  $\text{NO}_x$ /MMBTU. The  $\text{NO}_x$  emissions from the diesel-fired equipment were calculated using EPA published AP-42 emission factors and the rated break horsepower of each engine. Annual emissions were based 100 percent load, operating all year for each piece of equipment.

Stack parameters for the various equipment types were selected based on previous modeling studies (Dames & Moore 1978, Radian 1982). The sources contained in these studies were surveyed for similarity to the GCF sources based on engine type, size, and use. Generally, when there were two or more pieces of similar equipment, the more conservative set of stack parameters were selected.

### 3.0 SCREENING ANALYSIS

The screening analysis employed dispersion modeling techniques to provide conservative estimates of the annual NO<sub>2</sub> concentrations that could be expected around the GCF. Concentrations were predicted utilizing the ISCLT model (UNAMAP version 6), the EPA-preferred model for evaluating dispersion from complex source configurations involving building wake effects (EPA 1986). The following elements were assumed in the analysis:

- due to a lack of engineering details regarding the facility, emission rates and stack parameters were estimated using the conservative assumptions discussed in Section 2.0 above;
- the GCF sources were conservatively assumed to be co-located;
- building wake effects were simulated assuming rectangular, adjacent structures approximately the same height as the release points;
- the regulatory default options for ISCLT were employed in the analysis. Note, tests of the model using the GCF sources, indicated that the results were not sensitive to the selection of individual program options.
- the meteorological data used in the modeling was comprised of an annual joint frequency distribution of wind speed, wind direction, and stability class obtained from the Prudhoe Bay area monitoring network during April, 1979 through March 31, 1980 (Radian 1981);

- the background level for  $O_3$  was assumed to be  $51 \text{ ug/m}^3$  (Radian 1981); and
- $NO_x$  concentrations from existing sources and permitted sources near Drill Site No. 7 were estimated as approximately  $40 \text{ ug/m}^3$  from contour plots contained in the air quality impact analysis for the AGCF (Radian 1982).

The results of the annual  $NO_x$  modeling for the GCF sources are presented in Table 2. Receptors were placed along a irregularly spaced rectangular grid out to 1000 m, with all the GCF sources located in the center. The highest annual  $NO_x$  concentration of  $311 \text{ ug/m}^3$  was predicted approximately 110 m west-southwest of the sources. This location aligns with the direction of the most frequent high wind velocities which were required to induce the building wake effects. Similar modeling runs assuming no building wake effects resulted in a much lower ground level concentration of  $68 \text{ ug/m}^3$ , at 300 m west-southwest of the sources.

In order to convert the  $NO_x$  concentrations to  $NO_2$  for comparison to the AAAQS, the Ozone Limiting Method (OLM) was applied (Cole and Summerhays 1979). The OLM assumes a 10 percent instack conversion to  $NO_2$  with the remainder of the conversion limited by the ambient  $O_3$  concentration (assumed to be  $51 \text{ ug/m}^3$ ). In addition, the contribution of other existing and permitted sources to the  $NO_x$  concentrations near the proposed site was assumed to be approximately  $40 \text{ ug/m}^3$ . When this background value is considered and the OLM applied, the maximum annual  $NO_2$  becomes  $83 \text{ ug/m}^3$ , below the applicable AAAQS of  $100 \text{ ug/m}^3$ . Note, that the OLM method depends heavily on the  $O_3$  background value, which at the PBU has been shown to be dependent on the intrusion of stratospheric  $O_3$  during storms (Evans 1982). Higher annual  $O_3$  background values would produce corresponding higher  $NO_2$  predictions.

#### 4.0 DISCUSSION

A screening analysis was applied to predict annual  $NO_2$  concentrations associated with a proposed GCF near Drill Site No. 7. The sources were assumed to be co-located and emission rates were based on a conservative set of

criteria. The results of the ISCLT modeling and the application of the OLM method indicated that annual NO<sub>2</sub> concentrations would be below the AAAQS. Considering the conservative nature of the analysis and provided the O<sub>3</sub> background concentrations assumed are representative, it is unlikely that the NO<sub>x</sub> emissions would not be a limiting factor in the placement of the GCF at this location.

#### 5.0 REFERENCES

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Technical Note: Air Quality Analysis of the Enhanced Oil Recovery/Central Compressor Plant Engineering Refinement to the Prudhoe Bay Unit. Submitted to the USEPA Region X, and the Alaska Dept. of Environmental Quality. December 9, 1983.
- Radian, 1982:  
Air Quality Control Permit to Operate Application for Alaska Gas Conditioning Facility, Prudhoe Bay, Alaska. Submitted to: Alaska Dept. of Environmental Quality, July 15, 1982.
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Air Quality and Meteorological Monitoring Study at Prudhoe Bay, Alaska, April 1, 1979 - March 31, 1980, Final Report. Submitted to the Prudhoe Bay Unit Operators, January, 1981.

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TABLE 1

Annual NO<sub>x</sub> Emission Rates and Stack Parameters  
 Yukon Pacific Corporation  
 Gas Conditioning Facility, Prudhoe Bay Unit

Source	#Units	Emission	Height (m)	Stack Parameters		
		Rate (g/s)		Diameter (m)	Exit Vel. (m/s)	Temp. (K)
Gen. Turb. (50,330 Bhp)	2	51.7	24	4.8	15.2	700
Gas Comp. (34,470 Bhp)	5	88.6	13	2.5	20.1	644
Gas Comp. (35,635 Bhp)	4	73.2	13	2.5	20.1	644
Gas Comp. (34,905 Bhp)	3	53.8	13	2.5	20.1	644
Glycol Heater (160 MMBtu/hr)	1	1.6	14	1.0	10.7	611
Emergency Gen. (3,500 Bhp)	1	10.7	7	.5	18.3	660
Air Comp. (200 Bhp)	1	0.8	8	.5	18.3	421
NGL/EOR Comp. (34,750 Bhp) (1)	1	17.9	13	2.5	20.1	644

(1) The booster turbine retro-fitted at the NGL/EOR was not included in the modeling analysis.

TABLE 2

Annual ISCLT NOX (ug/m3) Predictions  
Screening Analysis for  
Yukon Pacific Corporation  
Gas Conditioning Facility, Prudhoe Bay Unit

y(m)	-1000	-750	-500	-300	-200	-100	-50	50	100	200	300	500	750	1000
1000	2.60	2.38	1.99	1.89	1.96	2.03	2.06	2.41	2.73	3.34	3.90	5.48	7.84	9.31
750	4.31	3.16	2.76	2.16	2.25	2.35	2.41	3.08	3.67	4.69	5.55	8.84	11.22	11.23
500	6.72	6.15	4.13	3.30	2.60	2.92	3.07	4.66	6.04	8.28	12.13	16.26	14.88	13.79
300	13.59	10.79	10.55	6.35	5.32	4.11	4.50	8.28	11.44	21.01	26.30	25.41	19.18	14.12
200	19.28	20.77	17.05	14.79	8.21	5.58	5.25	12.61	21.47	37.80	39.95	31.51	18.45	13.40
100	25.29	31.85	44.42	43.84	28.85	11.09	8.38	40.48	74.61	74.26	53.46	29.16	17.57	12.59
50	28.35	37.46	59.35	87.88	98.52	52.15	17.68	147.64	158.96	76.11	48.39	27.21	16.62	12.18
-50	31.11	42.97	72.80	128.10	190.48	311.17	144.31	20.17	34.04	36.78	31.21	21.38	14.25	11.01
-100	30.76	42.67	70.42	118.54	147.41	78.52	40.68	14.04	12.90	20.70	21.64	17.87	12.92	10.28
-200	30.11	40.11	63.67	69.37	45.86	23.74	16.75	12.68	11.06	9.30	11.88	11.26	10.24	8.85
-300	29.44	37.67	45.22	32.83	24.63	13.09	12.86	11.14	9.98	8.26	7.00	8.20	7.79	7.48
-500	25.63	25.11	21.12	14.26	8.58	8.43	8.28	7.65	7.16	6.12	5.46	4.45	5.32	5.42
-750	18.16	15.33	12.11	7.57	7.22	6.89	6.72	6.27	5.96	5.36	4.83	4.12	3.39	3.87
-1000	12.71	10.90	7.88	6.36	6.14	5.91	5.79	5.47	5.26	4.84	4.42	3.74	3.18	2.73

193.0/4-T2

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### ATTACHMENT 3

#### LNG PLANT SAFETY

LNG marine tank ships and LNG land-based facilities have been safely operated for more than twenty years. This record has been achieved due in part to the stringent standards used in siting, design, construction, operations, and maintenance of these facilities, as well as special training provided for all personnel involved in operations. Historically, most land-based LNG facilities have been built to National Fire Protection Association (NFPA) Standard 59-A, "Storage and Handling of Liquefied Natural Gas". All LNG marine tank ships have been designed to International Maritime Organization (IMO) Standards, "Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk".

With the adoption of 49 CFR 193 in 1980, regulatory responsibility for the proposed TAGS LNG plant falls under the jurisdiction of the U.S. Coast Guard and the Materials Transportation Bureau (MTB) of the Department of Transportation (DOT). The U.S. Coast Guard will be responsible for the marine cargo transfer system and associated facilities that are between the marine vessel

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and the last valve located immediately before the storage tanks. The MTB will be responsible for the remainder of the plant.

The proposed TAGS LNG Plant facility will be developed in accordance with the Pipeline Safety Regulations of the U.S. Department of Transportation. The Code of Federal Regulations Title 49, Subchapter D, Part 193 (49 CFR 193) prescribes Federal Pipeline Safety Standards for liquefied natural gas facilities. Analysis conducted by the Yukon Pacific Corporation (YPC) indicates that the Anderson Bay site can be developed in compliance with 49 CFR 193.

Recognizing the commitment to safety embodied in this code, it has been used as the basis for evaluation of the proposed LNG plant site, for development of a conceptual definition of the LNG plant, and for LNG plant safety planning. As the TAGS project progresses, these regulations will continue to be used as the primary standard for specific siting requirements, design, construction, equipment, operations, maintenance, personnel qualifications and training, fire protection, and security of the proposed LNG facilities.

#### LNG PLANT SAFETY AND CODE REQUIREMENTS

The excellent safety record of LNG facilities has been accomplished by integrating safety considerations into each

step of planning, from conceptual design through operation. Safety is implemented at various levels, including siting, design, construction (including quality control and selection of materials and equipment), training, active mitigation (including emergency shutdown systems), and passive mitigation. The 49 CFR 193 Code details the levels of safety as follows:

Subpart B - Siting Requirements

Subpart C - Design

Subpart D - Construction

Subpart E - Equipment

Subpart F - Operations

Subpart G - Maintenance

Subpart H - Personnel Qualifications and Training

Subpart I - Fire Protection

Subpart J - Security

From initial plant conception through plant commissioning, the physical layout and design of the LNG facility will proceed in parallel with code compliance evaluation.

Subpart B prescribes siting requirements for LNG facility location. Included specifically are general site size, topography and configuration requirements; thermal radiation protection requirements; flammable vapor-gas

dispersion protection requirements; seismic investigation and design requirements; flooding requirements; soil requirements; wind requirements; severe weather and natural occurrence requirements; requirements for adjacent facilities; and requirements for separation of facilities. During conceptual definition and layout of the proposed TAGS LNG plant, each of these requirements has been considered at a level of detail appropriate for development of the Environmental Impact Statement. During later definitive design stages of the project, specific and more detailed siting analyses will be integrated with physical layout/design optimization.

Thermal radiation and vapor dispersion exclusion zone computations will be required during definitive design to ensure that the selected site has adequate land area under the control of the facility operator or by government entities under agreement with the operator. Further seismic investigation will be conducted to determine the most critical ground motion for facility design purposes. Site geotechnical investigations will be conducted to ensure that sufficient load-bearing capacity is available to support static loading of facility components and contents, including any hydrostatic testing or dynamic loading that could occur. Final design will be based on these site specific findings.

The requirements of Subpart C - Design will be addressed during the definitive facility design stages. Selection of suitable materials for use in the facility will be made after thermal and mechanical design loads imposed by the cryogenic operating conditions are considered, as well as ambient weather conditions that will be encountered at the facility site. Equipment and buildings, including their foundations and support systems, will be designed to withstand all applicable loadings without loss of functional or structural integrity. Particular attention will be given to ice and snow loadings.

The design of the facility drainage and impoundment system will be developed along with design optimization efforts. Design of the drainage and impoundment system will be integrated with thermal radiation and vapor dispersion analyses. The final impoundment design will address all items in 49 CFR Sections 193.2149 through 193.2185. Design for seismic forces and hydrodynamic or impingement forces of jetting LNG will ensure structural integrity of the impoundment. Drainage will be designed to enhance the natural movement of water into collection sumps for removal. Impoundment and drainage will be designed, wherever possible, to allow easy access by mechanized snow and ice removal equipment.

The LNG storage tanks will be designed and constructed by a contractor with previous experience in cryogenic tank design. The contractor will be required to show compliance with paragraphs 193.2187 through 193.2221 of 49 CFR 193. The tanks will be equipped with sufficient pressure and vacuum relief valves so that the maximum or minimum allowable pressure limits of the tank will not be exceeded by any combination of rise or fall in barometric pressure, rollover, withdrawal or recirculation of liquid or gas, addition of subcooled LNG, or failure of compression equipment. The undertank heating systems will be designed to prevent development of frost heave forces beneath any part of the tank bases. Selection of steel for the LNG tank outer shell will be made to ensure that nil ductility temperatures of the steel are well below the anticipated minimum shell temperature. Transfer systems will be designed in accordance with Sections 193.2223 through 193.2233.

Adherence to Subpart D, paragraphs 193.2301 through 193.2329, during facility construction will ensure that the facility is built in accordance with the intent of the design. Quality control and quality assurance manuals will be prepared for field use. Welder certification will be closely monitored to ensure that individual welders are qualified as per welding procedures developed in accordance

with applicable codes. Non-destructive weld examination and hydrostatic testing will conform to the Subpart D requirements. As required by paragraph 193.2329, specifications, procedures, drawings, test results, inspection reports, and quality assurance reports will be retained.

Each item of equipment or subsystem used at the LNG facility will conform to the requirements set forth in Subpart E - Equipment. Particular attention will be given to the location of shutoff and control valves, relief devices, and sensing devices. All control systems will be designed to fail in a safe condition. All critical plant functions, including but not limited to electrical control systems, communication, emergency lighting, and fire-fighting systems, will have at least two sources of power that operate so that the failure of one source does not affect the capability of the other.

Emergency shutdown systems will be provided to serve the liquefaction process units and the LNG storage and loading areas. The emergency shutdown system will be capable of manual or automatic actuation. Within the process train area, actuation of the emergency shutdown system will terminate natural gas flow to the plant, shut down the refrigerant compressors and pumps, and isolate the LNG product line. Where necessary, in-process natural gas, fuel gas, and refrigerant gases will be vented to the

plant flare system. In the LNG storage and loading area, the emergency shutdown system will be designed to shut down LNG tanker loading pumps and close transfer piping isolation valves. Each section of isolated LNG line will be provided relief valves. Relief valves will discharge into a vapor header, which will relieve pressure to the flare system if necessary.

Before plant commissioning, a set of operating manuals will be prepared. These operating manuals will provide written procedures to allow safe operation of the facility. These procedures will cover both normal and abnormal operations, including cool-down procedures for cryogenic equipment as well as start-up and shut-down procedures. A separate emergency procedures manual will be prepared. This manual will identify the types of emergencies (both fire and non-fire related) and their location, present a plan of action to deal with each emergency, and detail the coordination and communication between plant personnel and local officials that will be necessary to handle severe emergency conditions. Written procedures will be developed for investigating and reporting failures in compliance with paragraph 193.2525. The LNG plant will have a separate primary and emergency communication system that complies with paragraph 193.2519. All paragraphs of Subpart F - Operation (193.2501 through 193.2521) will be complied with.

Facility siting, design, and construction will be in compliance with 49 CFR 193 and its referenced codes and regulations to provide an initial high level of safety. Proper maintenance procedures will ensure continued safe operation of the facility. A complete set of maintenance procedures will be prepared for all plant equipment. These procedures will include both preventive and normal maintenance functions. An inspection program will be implemented to identify potential problems before they become hazardous. A corrosion monitoring program will be established to monitor and inspect the LNG tanks and other equipment where corrosion is anticipated. As required by paragraph 193.2639, complete maintenance and inspection records will be retained by the operator.

Only companies and/or individuals who have demonstrated competence by training and experience in the design or fabrication of comparable components will be used during the design and fabrication of the facility. Facility personnel employed in the areas of operations, maintenance, security, and fire protection will receive appropriate training as required by Subpart H - Personnel Qualifications and Training. Those employees with multiple responsibilities (i.e., operations and fire protection) will receive training in all areas necessary for the correct performance of their duties. A fire protection

training plan will be implemented and given to plant personnel involved in fire protection. It will also be made available to local fire protection personnel. A record-keeping program will be initiated to provide evidence of compliance with all paragraphs of Subpart H.

A facility fire protection system will be installed. The purpose of this system will be to detect releases of hazardous materials and fires, and to provide protection for personnel and equipment should a fire occur. Potential sources of ignition, both inside and adjacent to the plant, will be identified, as well as those areas where flammable fluids might exist.

Based on this identification of fire hazard sources, a fire protection and hazardous release detection system will be designed. This system will use all available appropriate hazard mitigation and detection measures, including:

- flammable gas detectors
- fire detectors
- low and high temperature detectors
- fire extinguishing equipment
- fire control equipment .
- appropriate flammable fluid storage
- hotwork and motor vehicle permits
- control of open fires and smoking

A conventional fire-water system will be used to extinguish fires involving such ordinary combustible materials as wood, paper, cloth, or similar cellulosic types. It will also be used as cooling water for exposure protection of facilities against the effects of thermal radiation. For hydrocarbon fires, fire-water lines, nozzles and hydrants will be provided throughout the plant. Water spray will be used to enhance LNG vapor dispersion during spill conditions. A high expansion foam system will be provided for application directly to LNG spills to significantly reduce fire intensity. For unignited LNG spills, high expansion foam will be utilized to significantly reduce potential downwind vapor-gas concentrations. Foam units will be installed at impoundment areas where LNG pool accumulation could occur. Dry chemical powder systems will be used to extinguish localized refrigerant fires, LNG, or natural gas fires. Hand portable and wheeled dry chemical units will be provided at storage, transfer line, and marine terminal locations. In the process areas both hand portable and hose line dry chemical units will be installed. Fire trucks with both dry chemicals and high expansion foam will be provided. An inert gas system will be installed for preventing explosions and extinguishing fires in enclosed spaces where flammable fluids are handled.

The fire protection system will encompass all the requirements of Subpart I, paragraphs 193.2801 through 193.2821, as well as pertinent sections of other subparts.

As required by Subpart J - Security, a separate manual of security procedures will be prepared. The manual will establish a security plan for the facility, including:

- a description and schedule of security inspections and patrols
- a list of security personnel positions or responsibilities for the facility
- a brief description of security personnel duties
- instructions for actions to be taken
- methods for determining correct access to facility
- methods for positive identification of persons entering the plant
- a plan of liaison with local law enforcement officials

Critical portions of the facility, as defined in paragraph 193.2905, will be appropriately enclosed as defined in paragraph 193.2907. Communications, lighting, monitoring, power sources, and warning signs will be in compliance with paragraphs 193.2309, 2911, 2913, 2915, and 2917.

## LNG PLANT SITING AND SAFETY CONSIDERATIONS

The Anderson Bay site has been selected for location of TAGS LNG plant and marine terminal facilities based upon the results of comparative evaluations with other candidate sites, and based on specific analyses with respect to the requirements of 49 CFR 193. Anderson Bay exhibits characteristics which make it a superior location for proposed LNG plant and port facilities as compared to alternatives in Prince William Sound and Cook Inlet. Site specific analyses show that the Anderson Bay site and LNG facilities will be capable of 49 CFR 193 compliance.

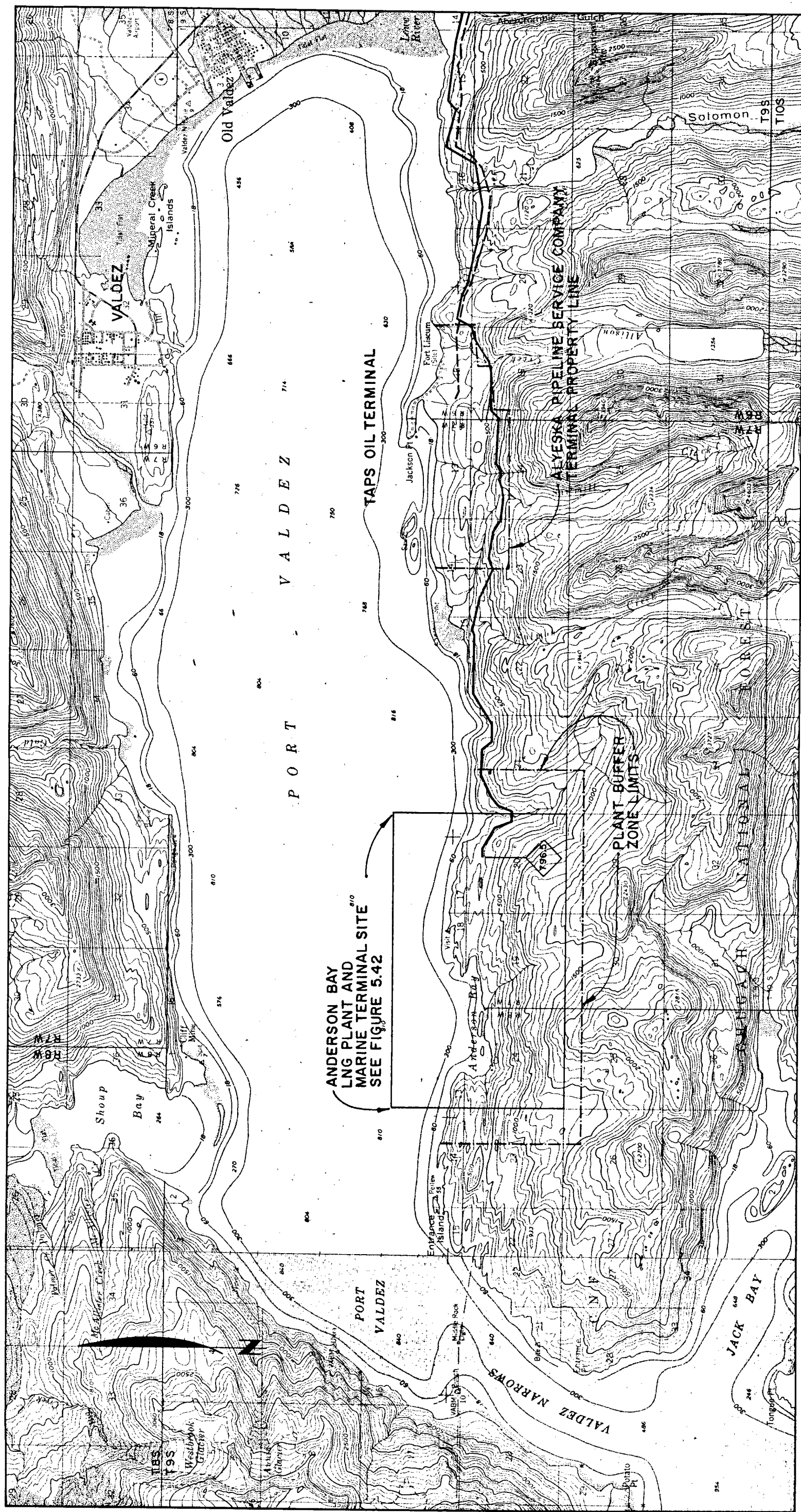
YPC has planned TAGS project development activities to occur in three discrete stages. Currently in Stage I, project conceptual definition, route selection, and site selections have been completed for Environmental Impact Statement (EIS) evaluation. Subsequent to the EIS process, it is intended that Stage I will conclude with acquisition of Federal and State Right-of-Way grants and Corps of Engineers permits. Definitive design including optimization, detailed engineering, and "Authorization to Proceed" permitting will occur during Stage II of the project. Stage III is planned as the project construction, testing, and startup period.

The proposed siting of TAGS LNG facilities specifically at Anderson Bay has been evaluated with respect to the requirements of 49 CFR 193. The purpose of this analysis was to: 1) provide reasonable assurance of the capability of the site to comply with 49 CFR 193; and 2) provide reasonable assurance that no site condition or code requirement might prevent the capability of the site to comply with 49 CFR 193. Where necessary, specific design parameters from project conceptual definition were used to evaluate the site with respect to code requirements. Siting requirements directly addressed by the code were reviewed and evaluated to provide reasonable assurance of compliance. However, in many cases code compliance will be governed by detailed design (Stage II) parameters rather than by actual site conditions.

Significant siting issues that relate to the acceptability of the proposed Anderson Bay LNG plant site with respect to the code requirements are summarized in the following sections. Where appropriate, conceptual project definition is discussed, along with the results of any specific analysis conducted to evaluate code compliance issues.

#### General- Site Size, Topography and Configuration

The Anderson Bay site is located on the south shore of Port Valdez, Alaska (see Figure 1). Port Valdez is an ice-free, weather protected fjord with established navigational



## LEGEND

- \_\_\_\_\_ PROPOSED TAGS PIPELINE (BELOW GROUND)  
 - - - - - EXISTING TAPS PIPELINE (BELOW GROUND)  
 - . - . - . PROPERTY LINE

## TAGS MILEPOST

SCALE 1:63360



CONTOUR INTERVAL 100 FEET



**YUKON PACIFIC CORPORATION  
TRANS-ALASKA GAS SYSTEM**

# LNG PLANT/MARINE TERMINAL SITE LOCATION MAP

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## Figure 1

slopes of 25 to 40 percent transition into the mountain-side. The majority of the site lies below the 200 foot elevation.

The site has well developed natural surface drainage. Four significant drainageways on the site channel surface water runoff from the mountainside and groundwater seepage into Port Valdez. A stream with a watershed of approximately five square miles east of the site drains into Port Valdez in the vicinity of "Seven Mile Beach", which is immediately east and adjacent to the site. Immediately west of the site, a stream with approximately a one and a half square mile watershed drains into the central beach area of Anderson Bay. Along the southern boundary of the area proposed for development, a creek directly upslope of the site drains into the east end of Anderson Bay. This drainage is oriented from east to west. It originates from a shallow lake lying at an approximate elevation of 180 feet at the east end of the site, flows to the west, and drains over cliffs into Anderson Bay. A short, steep drainage with a relatively small watershed on the west edge of the site flows into the east end of Anderson Bay.

Conceptual definition of the TAGS project included development of layout requirements for each area of the LNG plant facility. Layout involved identifying developable site areas that met the specific land requirements for each facility established during conceptual definition.

Analysis indicated that approximately 250 acres of site area will be required for placement of permanent facilities. An additional area of approximately 50 acres adjacent to the site is suitable for temporary off-loading and site access purposes.

The process area layout was based on the use of four each 600 million cubic feet per day (MMCF/D) liquefaction trains, and requires approximately 50 acres of developable site area. Liquefaction trains were sized during conceptual definition, and will require individual battery limit dimensions of 495' x 430' in plan. The battery limit area for each liquefaction train was sized to include all exchangers, transfer piping, turbine/compressor units, aerial cooling units, and a power substation. For safety and access, the conceptual layout for the process units was developed as a four-train-in- parallel rectangular arrangement with 150' wide roadways between battery limits. This 150' separation provides safety to adjacent units in the event that there is a fire in any single unit. The roadways will also provide access for fire fighting equipment in the event of a process unit fire. Complete perimeter roadways for each unit will allow multiple access and egress points during an emergency.

The LNG storage and impoundment area conceptual layout was based on the use of four 800,000 barrel storage tanks and medium wall dikes, and requires approximately 50 acres of developable site area. Individual storage tank sizes developed during conceptual definition were 268' outside diameter x 100' outside shell height. Several impoundment systems were evaluated during conceptual definition, with selection of a four cell system of 670' x 580' x 18' high reinforced concrete wall dikes. The cells were sized for isolated containment of 150 percent of the contents of each storage tank. This layout was developed as a four-in-line rectangular arrangement with each dike having a single common wall. A 100' wide perimeter roadway will provide access to the storage tank and impoundment area. The area is also sized to accommodate pipe racks for transfer piping.

Approximately 50 additional acres of developable site area is required for layout of various power plant facilities, utility storage areas, wastewater treatment, and emergency facilities. Although there is more flexibility for arrangement of these facilities than for either the process or storage and impoundment areas, each will require a layout that provides safe primary access along with an alternate emergency access, protection against fire hazards, convenience to communications and utilities, and overall material handling and operating efficiency.

Tanker berth, cargo vessel berth, and ferry landing facilities will require adequate shoreline land area for transfer piping, utility piping, harbor master facilities, equipment access, personnel access, security fencing, and fire protection facilities. It was determined that 20 acres of developable shoreline land area will be required for layout of marine facilities based on conceptual definition of a two tanker berth marine terminal and required cargo vessel berthing facilities. In order to allow sufficient maneuvering space for tankers, 1400' tanker berth spacing will be required along the shoreline. In addition, a 1500' distance is the minimum spacing between cargo berth facilities and any LNG loading platform.

Based upon conceptual definition of the plant relief system, approximately 40 acres of surrounding fenced security area is required for the process flare stack. The sizing of the process flare stack during conceptual definition was for blocked discharge of one liquefaction train through a relief header, with resulting dimensions of 200' height x 54" diameter. The dimensions of the required fenced security zone includes the area in a radius of 750' around the base of the flare stack. This area was determined as the radiation zone exceeding 2000 Btu/hr-ft<sup>2</sup> around the flare.

Conceptual definition of plant construction activities determined the need for additional land requirements for use during construction. It is estimated that an additional 50 acres of offloading and laydown area will be required. Sufficient land area will also be needed to provide an access road with a maximum 2 percent grade between the offloading area and facility areas. Maximum module loads of 2500 kip (kip=1000 lbs) have been identified during conceptual definition of the access road requirements.

Based upon the results of air photo interpretation, site terrain unit mapping, and the feasibility evaluation, it was determined that the Anderson Bay site can be developed at three major graded bench elevations. An upper bench graded to elevations of approximately 155' to 165' can be constructed to accommodate placement of pipeline gas receiving facilities, process units, power plant, and operational control and maintenance facilities. A middle bench graded to an approximate elevation of 100' can be constructed to accommodate placement of LNG storage tanks and impoundment, and can provide excess area for material laydown during construction. A lower bench graded to elevations of approximately 50' to 60' can be constructed to accommodate harbormaster facilities, shoreline berth and dock entrances, and wastewater treatment facilities. An

isolated area of this lower elevation bench can also be used to accommodate the marine flare stack and required security area during operations.

The upper bench at Anderson Bay can be developed to provide 50 acres for location of process facilities. The size and shape of the developable area is sufficient for arrangement of process trains as conceptually defined. Four liquefaction trains each requiring battery limits of 495' x 430' can be arranged in a parallel, rectangular configuration. Sufficient developable area exists for construction of 150' wide roadways separating each liquefaction train, and for construction of a complete perimeter roadway system around the process area.

The upper bench at Anderson Bay can also be developed to provide approximately 30 acres of site area for location of power plant, maintenance, and operating facilities. A 15 acre area east of and adjacent to the proposed process area provides sufficient area for the high pressure gas pipeline receiving facilities and plant operational control facilities. An additional 15 acres adjacent to and west of the proposed process area provides sufficient site area for power plant and maintenance facilities.

In order to develop the upper bench facility area, it will be necessary to cut, level, and grade original site topography from elevations in excess of 200' to construction grades of approximately 165'. Along the southern boundary of the site, it will be necessary to make rock cuts to elevations above the 300' contour line in the existing backslope.

The middle bench at Anderson Bay can be developed to provide as much as 75 acres of site area for location of LNG storage tanks and impoundment. The size and shape of the developable area is sufficient for arrangement of tanks and dike structures as conceptually defined. Four 800,000 barrel tanks, each with 670' x 580' of dike area, can be configured as a four-in-line rectangular arrangement. Sufficient developable area also exists for construction of a 100' wide perimeter roadway system and to allow placement of pipe racks for transfer piping.

At the east end of the middle bench area there is sufficient space for placement of utility storage tanks and dike structures. Utility storage in this area would be for diesel, propane, and ethylene.

At the west end of the middle bench area there is sufficient space for an equipment and material laydown area during construction, and/or for future siting of additional

LNG storage tanks if the need should ever arise. Based upon the feasibility evaluation, it was determined that two additional 800,000 barrel tanks could be located in this area utilizing conceptually defined layout geometries. By using higher dike walls with corresponding smaller plan dimensions, it would be possible to locate as many as eight 800,000 barrel tanks on the middle bench.

In order to develop the middle bench facility area, it will be necessary to cut, level, and grade original site topography from elevations in excess of 200' to construction grades of 100'. Between the upper and middle benches, it will be necessary to construct rock cut slopes from 55' to 65' in vertical height. It may be possible to use these rock cut slopes for natural impoundment walls behind LNG storage tanks.

The lower bench at Anderson Bay can be developed to provide approximately 50 acres of site area to accommodate harbor-master activities, shoreline berth and dock facilities, wastewater treatment facilities, and process flare stack security. During construction, this area can be used for camp and living facilities. Harbormaster and cargo berth shore facilities can be placed on approximately 10 acres at the east end of the site, and adjacent to the shoreline. Between the east and west ends of the site, approximately

20 acres of shoreline land area will allow development of access roadways, transfer piping, and shoreline security features.

Approximately 20 acres of lower bench area at the west end of the site are sufficient for location of wastewater treatment facilities and placement of the process flare stack. Locating the process flare stack at the end of a narrow point of land will require fencing of approximately 10 acres of actual land area as a security zone. The remaining 30 acres of the flare stack security zone will be water area at the east end of Anderson Bay.

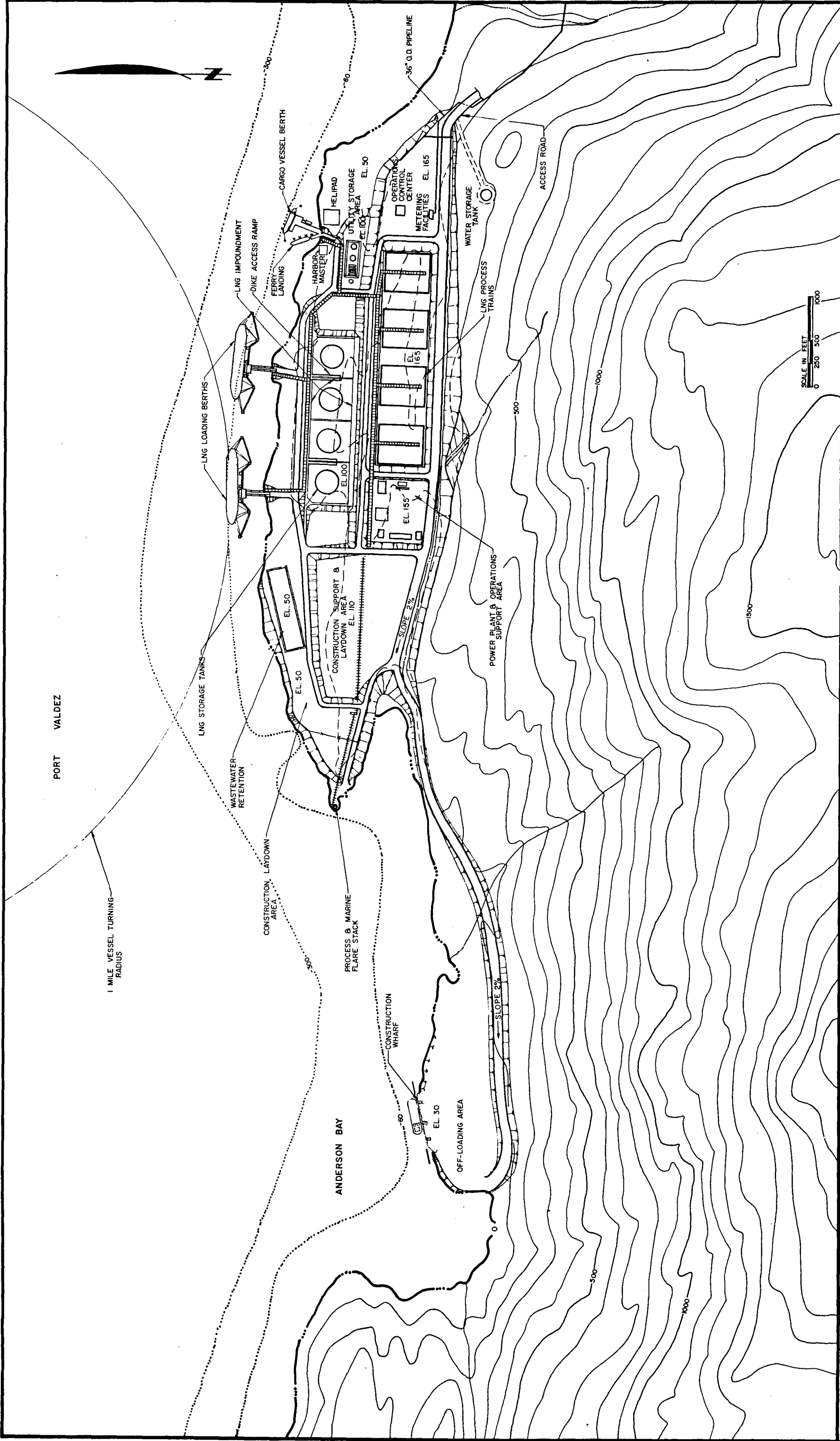
In order to develop the lower bench facility area, a combination of cut and fill will be used to grade the lower bench to construction elevations from 50' to 60'. Between the site middle and lower benches, it will be necessary to construct rock cut slopes from 40' to 50' in vertical height. High quality rock fill material obtained from site excavation activities will be used for all fill areas.

Just west of the site in a shallow area of Anderson Bay are a group of rock islands that can be developed into a 50 acre area sufficient to construct temporary module offloading and access facilities. Construction of an offloading area in Anderson Bay will require filling approximately 35 acres with high quality rock fill material. In addition, high quality rock fill will be

needed for the access road connecting the offloading area and higher elevation facility areas. It is anticipated that ample rock fill material can be obtained from site excavation activities.

Based on these analyses, Anderson Bay has been determined to be of suitable size, topography, and configuration to safely accommodate the proposed TAGS LNG plant facility. All areas, distances, separations, impoundments, and access-ways developed during conceptual definition of the LNG plant facility can be accommodated in a plant layout configuration at Anderson Bay. The resulting LNG plant/marine terminal site layout (see Figure 2) is reasonably constructable and offers a design that minimizes hazards. LNG tanker berths can be safely located along the Port Valdez shoreline east of Anderson Bay as shown in Figures 3 and 4.

Layout of the Anderson Bay site has considered emergency access. Cargo vessel berth and ferry landing facilities at the extreme east end of the site and an alternative off-loading dock area at the extreme west end of the site will provide ease of access for personnel, equipment, and materials in the event of an emergency. Multiple access routes are available to any site area from either dock area to facilitate fire fighting, spill control, or personnel evacuation.



LNG PLANT/MARINE TERMINAL  
SITE LAYOUT, ANDERSON BAY,  
PORT VALDEZ, ALASKA  
Figure 2

**YUKON PACIFIC CORPORATION  
TRANS-ALASKA GAS SYSTEM**

<b>LEGEND</b>	FLARE SYSTEM PIPING (ABOVE GROUND)
..... WATER DEPTH (FT. BELOW MLLW)	===== INTERCONNECTING PIPEWAY (OVERHEAD)
----- SHORELINE (MLLW)	===== DIKED AREAS
----- GROUND ELEVATION CONTOURS	===== ROCK CUT SLOPE OR FILL SLOPE
----- ORIGINAL GROUND ELEVATION CONTOURS	

PORT VALDEZ

1 MILE VESSEL TURNING  
RADIUS

ANDERSON BAY

OFF-LOADING AREA

CONSTRUCTION WHARF

PROCESS & MARINE  
FLARE STACK

CONSTRUCTION LAYDOWN  
AREA

WASTEWATER  
RETENTION

LNG STORAGE TANKS

LNG LOADING BERTHS

LNG IMPOUNDMENT

DIKE ACCESS RAMP

FERRY LANDING

CARGO VESSEL BERTH

HARBOR MASTER

UTILITY STORAGE

EL. 100

EL. 50

OPERATIONS  
CONTROL CENTER

METERING  
FACILITIES

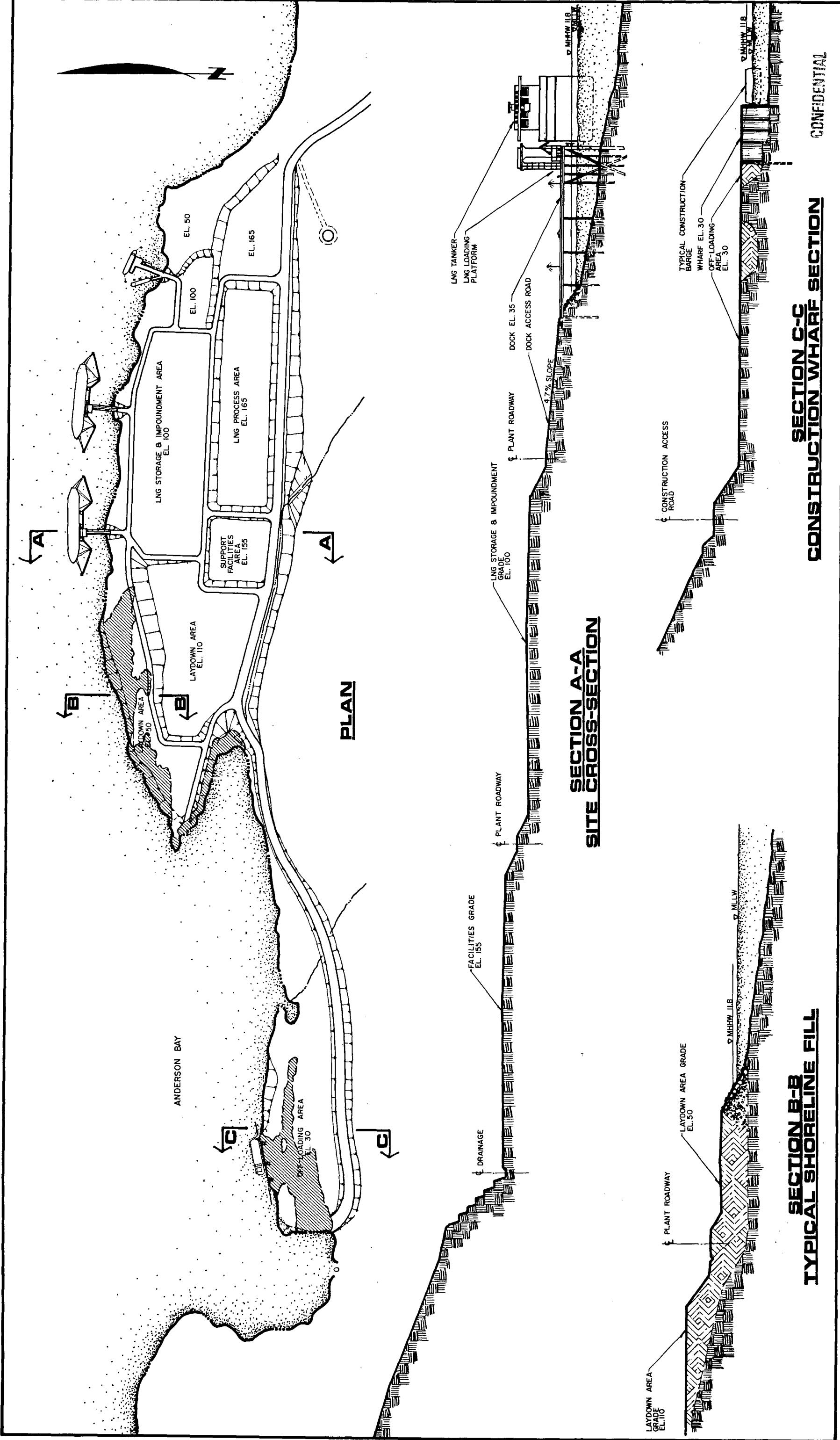
EL. 165

WATER STORAGE  
TANK

LNG PROCESS  
TANKS

ACCESS ROAD

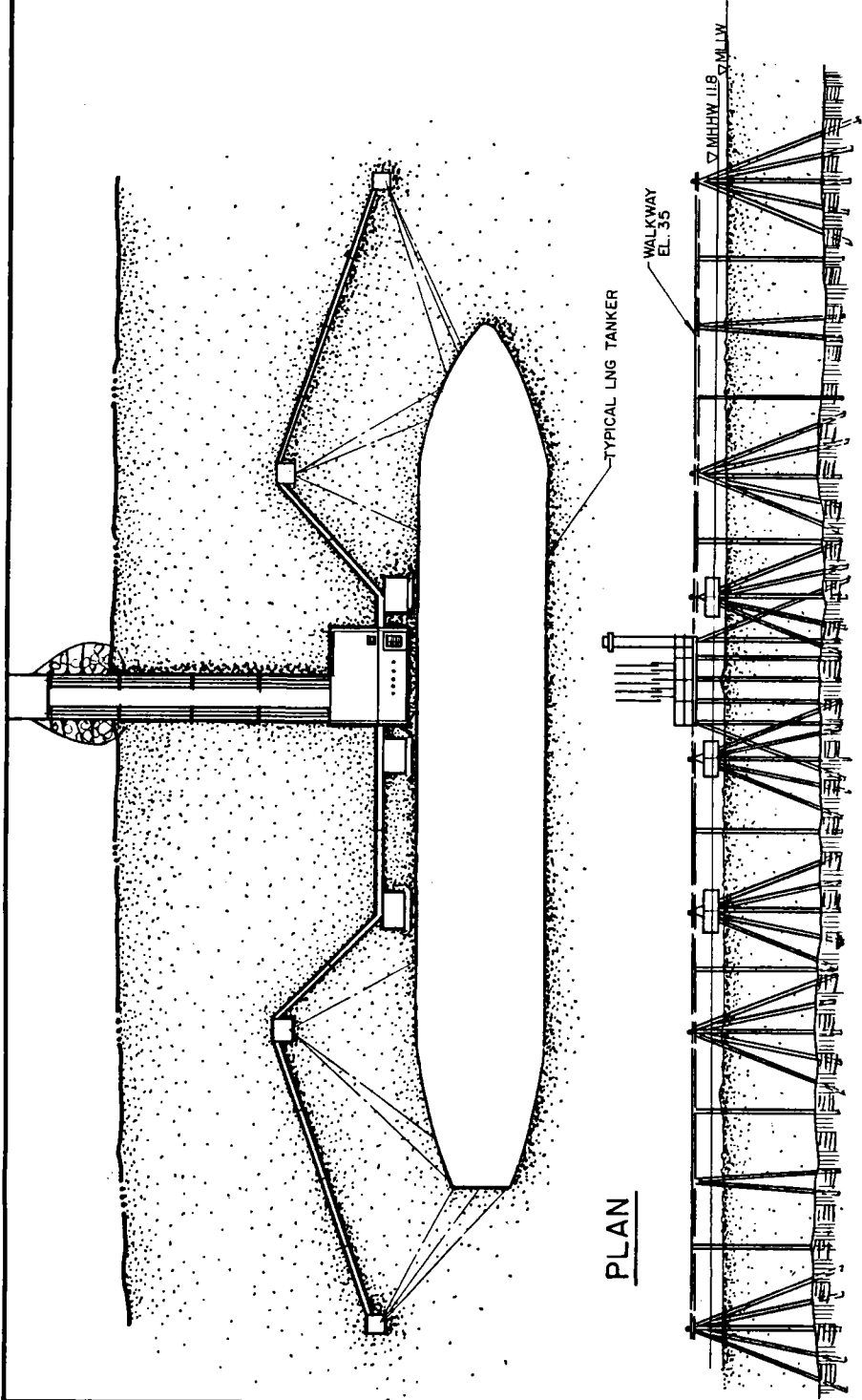
SCALE IN FEET  
0 250 500 1000



<b>YUKON PACIFIC CORPORATION</b> <b>TRANS-ALASKA GAS SYSTEM</b>	<b>MARINE TERMINAL DETAILS</b> <b>ANDERSON BAY</b> <b>PORT VALDEZ, ALASKA</b>
<b>LEGEND</b> FINAL SHORELINE EXISTING SHORELINE WATER ORIGINAL MATERIAL FILL MATERIAL STRUCTURAL ROCK FILL ROCK CUT SLOPE OR FILL SLOPE SHEET PILE SEA WALL (SIDE VIEW)	<b>SECTION C-C</b> <b>CONSTRUCTION WHARF SECTION</b> <b>CONFIDENTIAL</b>

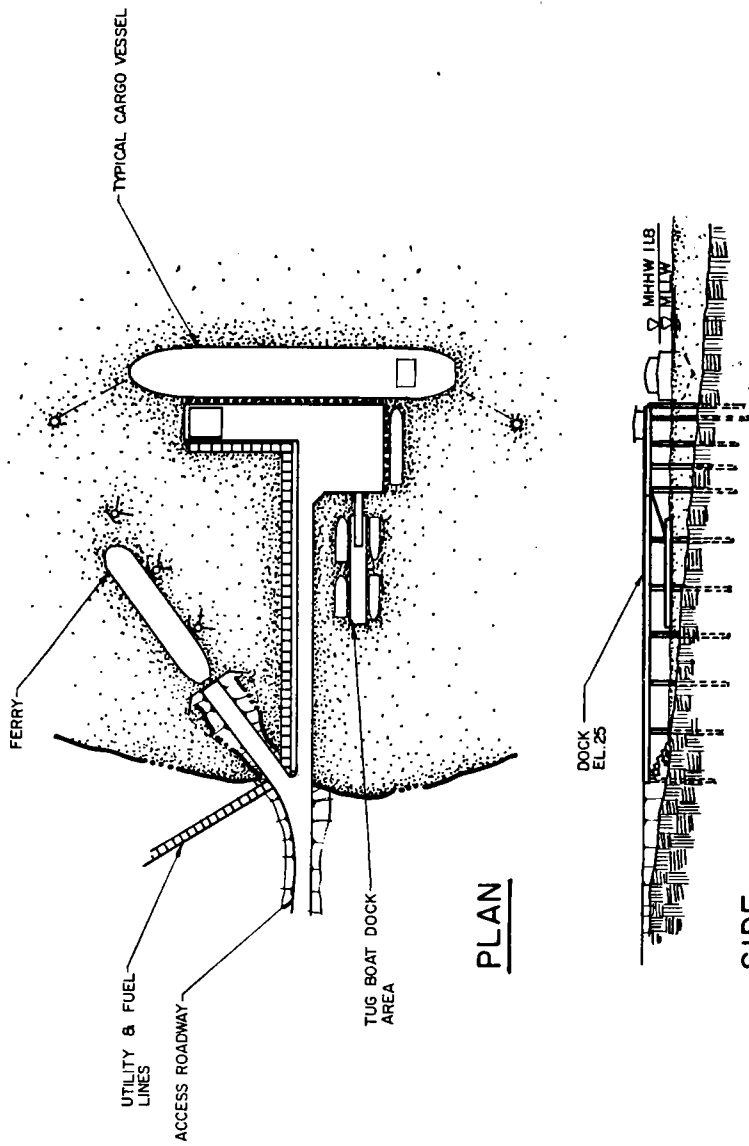
Sheet 1 of 2 Figure 3

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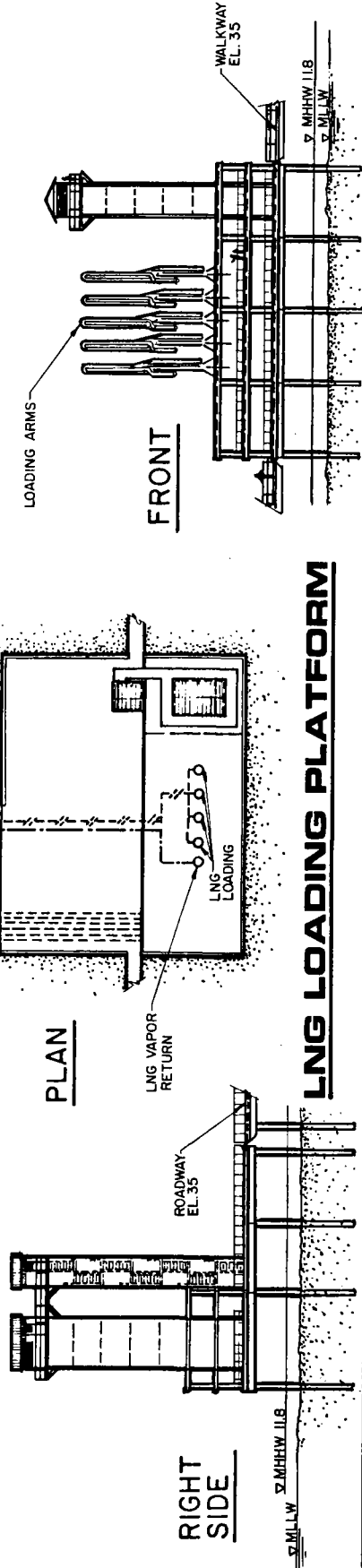
**LNG DOCK**

**FRONT**



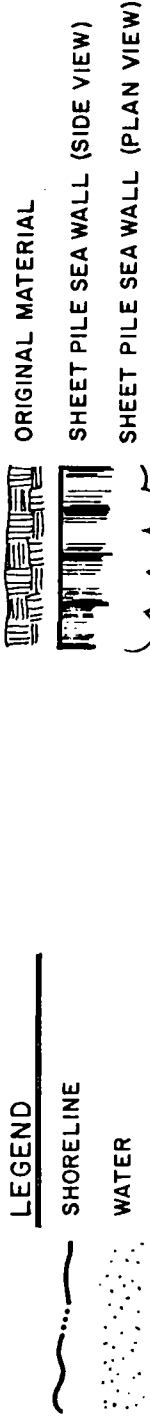
**CARGO & FUEL DOCK**

**CONFIDENTIAL**



**LNG LOADING PLATFORM**

**LEGEND**



**YUKON PACIFIC CORPORATION  
TRANS-ALASKA GAS SYSTEM**

**MARINE TERMINAL DETAILS  
ANDERSON BAY  
PORT VALDEZ, ALASKA**

Sheet 2 of 2 **Figure 4**

FEB. 9, 1987

## Thermal Radiation Protection

Significant to siting of an LNG plant, thermal exclusion zones are postulated worst case radiant heat flux areas inside of which specified public or private facilities may not be located, unless an LNG facility of the operator.

Calculation of thermal exclusion zones for the proposed TAGS LNG plant shows that the proposed facility can be safely sited at Anderson Bay and meet the thermal radiation protection requirements of 49 CFR 193. Maximum incident radiant flux values from postulated LNG pool fires have been calculated to assess the effect on publicly or privately used lands in the Port Valdez area. Results of the thermal radiation analyses have been used to further refine the LNG plant facilities definition.

Thermal exclusion distances were calculated for an LNG pool fire within a typical storage tank dike, LNG pool fires within transfer system impoundment areas, and a pool fire for a loading arm spill onto water. Calculations were initially performed for the LNG plant conceptual layout, and subsequently after the conceptual layout was modified based on the results of various LNG safety analyses.

Several "target" areas of public or private use were identified within the vicinity of Port Valdez. Analysis indicates that each of these target areas is located

outside of the plant thermal exclusion zone associated with incident flux greater than 1,600 Btu/hr-ft<sup>2</sup> for each postulated LNG pool fire. The target areas were as follows:

North Shoreline of Port Valdez	14,300'
Entrance Island	14,800'
Shoup Bay Spit	15,000'
Alyeska Pipeline Service Company Property Line	16,500'
Mouth of Mineral Creek	25,600'
City of Valdez	31,400'
Old Valdez	44,000'

Thermal radiation calculations were performed for both conditions of atmospheric attenuation as well as for unattenuated conditions. Unattenuated flux considers no adsorption or scattering of the radiation as it travels from the flame through the atmosphere. Wind speed and relative humidity are significant parameters affecting the flux levels from an LNG pool fire. These parameters were used in the analysis to develop a prediction of longer exclusion distances than would be created by other weather conditions at the site at least 95 percent of the time, based on Valdez climate data.

Thermal radiation analyses were performed using an American Gas Association methodology. This methodology has been validated with large-scale tests on LNG and liquefied

petroleum gas (LPG) fires, and has been accepted by the Materials Transportation Bureau of the U.S. Department of Transportation.

Results of thermal radiation analyses for each postulated LNG pool fire indicated that the greatest thermal exclusion distances were for the contents of an 800,000 barrel LNG storage tank spilled and burning within its impoundment. Utilizing a 450' x 450' x 35' high dike (modified from a 670' x 580' x 18' high dike), thermal radiation calculations indicated that unattenuated incident radiant flux levels of 1,600 Btu/hr-ft<sup>2</sup> extend a maximum distance of 1,726 feet from the center of any tank dike. Attenuated flux levels of 1600 Btu/hr-ft<sup>2</sup> extended a maximum distance of 1,509 feet from the center of any dike. For all of the other postulated pool fires, maximum distances for unattenuated flux levels of 1600 Btu/hr ft<sup>2</sup> were less than 1,726 feet.

As prescribed by 49 CFR 193, 1600 Btu/hr-ft<sup>2</sup> is the lowest limiting value for incident radiant flux on an offsite target. All public and private land-use target areas lie outside of the 1600 Btu/hr-ft<sup>2</sup> unattenuated flux isopleth. Based upon the results of thermal radiation analyses, development of the Anderson Bay site will comply with the radiation protection requirements of 49 CFR 193. Final thermal exclusion zones will be determined during detailed project design, along with optimization of

process, storage tank, transfer system and related impoundment designs.

#### Flammable Vapor-Gas Dispersion Protection

Dispersion exclusion zones have been calculated for the proposed TAGS LNG plant, showing that the proposed facility will meet the flammable vapor-gas dispersion protection requirements of 49 CFR 193. Significant to siting of an LNG plant, dispersion exclusion zones are postulated worst-case vapor-gas dispersion areas inside of which specified public or private facilities may not be located, unless an LNG facility of the operator. Maximum downwind dispersion distances from postulated LNG spills have been computed to assess the effect on publicly or privately used land areas in Port Valdez. Results of the vapor dispersion analyses have been utilized in further refinement of LNG plant facilities definition.

Dispersion distances were computed for an LNG spill from a typical storage tank into impoundment, for LNG spills from transfer systems into impoundment areas, and for a loading arm spill onto water. Distances were computed initially for the LNG plant conceptual layout, and subsequently after modification of the conceptual layout based upon initial vapor dispersion analyses.

Several "target" areas of public or private use were identified within the vicinity of Port Valdez. Analysis indicates that each target area is located outside of the plant dispersion exclusion zone associated with average gas concentrations of 2.5 percent in air for each postulated LNG spill. The target areas are as follows:

North Shoreline of Port Valdez	14,300'
Entrance Island	14,800'
Shoup Bay Spit	15,000'
Alyeska Pipeline Service Company Property Line	16,500'
Mouth of Mineral Creek	25,600'
City of Valdez	31,400'
Old Valdez	44,000'

Vapor dispersion analyses were performed for atmospheric conditions which result in longer predicted downwind dispersion distances than would be created by other weather conditions at the site at least 95 percent of the time, based on Valdez climate data. Analyses were also performed for the most prevalent atmospheric conditions.

Vapor dispersion analyses were performed utilizing two models to evaluate each postulated spill, and were run for each set of atmospheric conditions. An American Gas Association model, "Evaluation of LNG Vapor Control Methods", 1974 was used in order to assess compliance with respect to 49 CFR 193.2059(c), published in 1980. A model developed

by the U.S. Coast Guard, "Development of an Atmospheric Dispersion Model for Heavier-Than-Air Gas Mixtures", 1985, was also used in order to consider recent developments in vapor dispersion technology.

The American Gas Association method does not consider many of the physical phenomena that occur in the dispersion of heavier-than-air vapor clouds. This method provides conservative values, predicting greater vapor dispersion distances than an actual vapor cloud would travel. In some cases where model results were compared with actual spills, predicted distances to the lower flammable limit have been almost an order of magnitude greater than actual distances.

Regulations provide for the use of other calculation methods if proper validation of the method can be provided. The U.S. Coast Guard model provides proper documentation and validation for the acceptance by 49 CFR 193 regulators to be used in vapor dispersion prediction. This model provides predictions of downwind gas concentration decay which agree with the full range of field experimental data currently available.

Results of vapor dispersion analyses for each postulated LNG spill indicated that the greatest vapor dispersion distances were for the case of an 800,000 barrel storage tank spill into impoundment, or for the case of a ten minute loading arm spill onto water at the rate of 12,000 gallons per

minute. Considering a 450' x 450' x 35' high dike (modified from a 670' x 580' x 18' high dike), results of the American Gas Association (1974) Model indicated that the maximum dispersion distance would extend 11,700' from the dike wall for the case of a storage tank spill into impoundment. Using the U.S. Coast Guard model (1985), a maximum vapor dispersion distance of 6,854' was predicted for this case. For the case of a ten minute loading arm spill onto water, predicted maximum vapor dispersion distances were 11,920' and 6,243' for the American Gas Association and U.S. Coast Guard models, respectively.

For all other postulated spills, maximum vapor dispersion distances predicted by the American Gas Association model were less than 5,000', and less than 2,200' as predicted by the U.S. Coast Guard model. The maximum vapor dispersion distance considering all cases for the most prevalent weather conditions was predicted to be 3,550' (American Gas Association model). Utilizing worst case weather conditions and the U.S. Coast Guard model for computing vapor travel over land, maximum vapor dispersion distances were predicted to be 3,600'. This value was used as an input to determining the TAGS LNG Plant land requirement.

When the results of vapor dispersion analyses are compared with the location of identified target areas, it is shown that development of the Anderson Bay site will comply with the flammable vapor-gas dispersion protection

requirements of 49 CFR 193. All public and private land-use target areas lie outside the computed maximum vapor dispersion distances. Final dispersion exclusion zones will be determined during detailed project design, along with optimization of process, storage tank, transfer system and related impoundment designs.

### Geologic and Seismic Considerations

The proposed TAGS LNG plant site at Anderson Bay is located within a Uniform Building Code designated seismic risk Zone 4. An on-site geologic reconnaissance and preliminary site seismic evaluation have been completed in order to develop confidence that the Anderson Bay site is capable of complying with 49 CFR 193 siting requirements.

The on-site geologic reconnaissance consisted of reconnaissance level geologic mapping, ground truth of terrain unit analyses, and verification of site elevations. Preliminary site seismic evaluations consisted of a deterministic estimation of most critical ground motion, preliminary probabilistic estimation of most critical ground motion, review of Quaternary faulting in the vicinity of Valdez, preliminary evaluation of soil stability and liquefaction potential, and review of rock slope stability.

Initial airphoto interpretation and subsequent on-site reconnaissance showed the Anderson Bay site was expected to be comprised of a series of east-west trending bedrock ridges mantled with glacial till and organic soils. Conceptual layout of LNG plant facilities considered development of excavated benches and associated rock cut and fill structures so that critical facilities could be founded on bedrock. The on-site geologic reconnaissance also confirmed the geologic and topographic assumptions used during conceptual definition and facilities layout. An additional goal of the reconnaissance was to map and observe structural lineaments on the site, specifically inspecting for any ground breakage that might indicate post-glaciation movement.

The bedrock encountered at the Anderson Bay site during geologic reconnaissance belongs to the Valdez Group, an extensive formation in Prince William Sound. The Valdez Group rock types include graywacke, phyllite, and inter-layered graywacke/phyllite. The rocks are metamorphic in nature, having recrystallized under greenschist facies conditions.

Rock discontinuities identified in the field include foliation, joints (fractures), and fault lineaments. Generally, the foliation strikes azimuth  $95^{\circ}$  to  $100^{\circ}$

and dips 60° to 65° to the northeast. Near the fault lineaments, variations in attitude occur. In specific, the strike shifts east and southeast and the dip of foliation flattens.

Based upon rock types observed in a traverse of the shoreline, it is estimated that the site area may consist of approximately 50 percent graywacke (quartzite), 40 percent interlayered rock, and 10 percent phyllite. These estimated quantities of high quality rock (graywacke) are greater than and an improvement over ratios assumed during conceptual planning.

Rock types are expected to provide adequate foundation support for proposed LNG plant facilities based on comparison of observations of the Anderson Bay site with experience at the Trans-Alaska Pipeline System (TAPS) terminal, located approximately 3 1/2 miles due east. All of the rock types observed will probably yield material suitable for general rock fill. The graywacke is expected to yield select rock material for use as drainage blankets, french drains, rip-rap, and armor rock. Field observations have generally confirmed previous airphoto interpretation and terrain unit mapping conducted to assess the type and relative thickness of soils overlying bedrock. The Anderson Bay site was also judged to be generally similar to the TAPS terminal site in terms of structural geology.

The approach for the conceptual development of the rock cuts at the Anderson Bay site can therefore be reasonably based on that used at the TAPS terminal.

Fault lineaments observed on the Anderson Bay site appeared to be geologically old, inactive structures. No evidence of active slippage was found during geological reconnaissance along the traces of fault lineaments. The presence of significant mineralization on or near well exposed shore- line faults supports evidence that they are old and inactive structures.

Geologic data and site reconnaissance observations serve to support the Anderson Bay site selection. No geologic conditions were observed that would preclude the use of this site for location of an LNG facility. Further geologic investigations and mapping will be conducted during detailed design stages of the TAGS project. Results of the completed geologic reconnaissance include data which will be useful in the planning stages of detailed geotechnical exploration programs.

In order to estimate seismic hazard at the Anderson Bay site, a deterministic approach has been taken to estimate most critical ground motion. The predominant feature which controls seismic hazard in the Valdez area is the gently dipping "Benioff-Wadati zone" that marks the boundary

between the Pacific and the Alaskan tectonic plates. A major seismic event could occur on the Benioff-Wadati zone, which lies 20 to 30 kilometers beneath Port Valdez. Peak ground acceleration estimates are based on data relating to seismic events associated with the Benioff-Wadati zone. A maximum seismic event directly beneath the site at a depth of 20 kilometers was considered for the deterministic evaluation of a peak acceleration at the Anderson Bay site. Use of a conservative attenuation equation gives a maximum deterministic ground acceleration peak value of 0.4g.

Preliminary probabilistic estimates of ground motion have been evaluated using tectonic models from prior studies in the region. These models were used with conservative attenuation relationships for the bedrock site conditions known to occur at Anderson Bay. Based upon an annual probability of exceedance less than 0.0001, a probabilistic peak ground acceleration value of 0.55g has been estimated for the Anderson Bay site.

Potential for Quaternary faulting in the vicinity of the proposed LNG plant site has been evaluated by reviewing the results of the on-site geologic reconnaissance, review of geologic literature on linears and faulting in the area associated with the 1964 Alaskan earthquake, and review of regional tectonics. Review of regional tectonics suggests

that fault activity within this region is related to three factors: 1) subduction and accretion of sediments during Mesozoic and early Cenozoic time; 2) counterclockwise rotation/bending of this portion of Alaska during the early Cenozoic Era; and 3) under-thrusting along the Benioff-Wadati zone that is active today. Based on examination of literature and mapping conducted after the 1964 event, no evidence was found for active faulting on land except at Montague Island, which is located about 90 kilometers to the southwest of the site. The faults that moved on Montague Island showed evidence of recent (Holocene) activity prior to displacement during the 1964 event. No evidence of active faulting has been observed in the vicinity of Valdez.

Based upon geologic and preliminary seismic reviews, no evidence of Quaternary faulting was found in the vicinity of the Anderson Bay site. Because the fault lineaments observed on the site are overlain by relatively young glacial till, the length of time over which direct evidence exists for inactivity is limited. However, regional studies suggest that the majority of movement on these faults occurred longer than 50 million years ago. At one location north of Valdez, glacial deposits overlie a mapped fault with no visible offset. Review of recent seismicity data collected since the 1964 earthquake shows no evidence of shallow linear earthquake patterns that suggest

near surface active faulting. In contrast, the data indicate that most of the earthquakes are deep and related to movement along the deeper Benioff Zone.

Preliminary evaluation of soil stability and liquefaction potential was based upon data and experience from nearby sites. Along the south shoreline of Port Valdez, it is reasonably expected that the offshore rock topography parallels onshore rock topography. This topography is a series of sharply stepping ridges of resistant rock, with gentler slopes between the steps. At the TAPS site, a varied thickness of soft sediments over these ledges smooths the bathymetric profile. The soft sediment is a glacial rock flour with grain sizes similar to that of clay particles, but with mineralogic and geotechnical properties similar to those of a very fine sand. The properties of the rock flour under simulated seismic loading in laboratory tests have shown that, while large deformations could occur, catastrophic strength loss which results in liquefaction failure is unlikely.

The Anderson Bay LNG plant and marine terminal will be constructed on excavated areas where shallow bedrock occurs. Critical facility areas will not be constructed on fill material. Marine terminal piers will be drilled through any fill or sediment into bedrock. Considering conceptual definition and layout at Anderson Bay, it is not

anticipated that pier design will be affected by soil liquefaction instabilities.

Preliminary evaluation of rock slope stability was based on results of the on-site geologic reconnaissance and experience with cuts in similar rock strata at the TAPS terminal. Site preparation for the proposed Anderson Bay LNG plant will require significant cutting and filling. A major feature will be the cut slope varying in height to a maximum of approximately 180 feet located along the southern boundary of the site. Based on conceptual definition and layout, this planned cut has a 1:1 slope, and will be less steep than both the bedding and foliation which provide a relatively stable configuration for rock cut slope stability.

Experience gained in a major cut slope behind the TAPS terminal power plant stresses the need to evaluate potential slope difficulties in detail during the design stage. Rock slope stability can be accommodated at the Anderson Bay site with proper design and construction techniques.

The results of on-site geologic reconnaissance and preliminary seismic evaluation indicate that the Anderson Bay site is capable of meeting seismic siting requirements of 49 CFR 193. No site conditions have been identified

that would preclude location of LNG storage tanks at Anderson Bay pursuant to 49 CFR 193.2061(f). Discussions with cryogenic tank manufacturers verify that 800,000 barrel storage tanks can be designed for maximum estimated seismic loads.

Further comprehensive geotechnical investigations and seismic evaluations will be conducted during detailed design stages of the TAGS project. LNG facilities will be designed and built to withstand, without loss of structural or functional integrity, all seismic design forces determined by the results of state-of-the-art seismic evaluation.

#### Flooding

Conceptual layout of the proposed TAGS LNG plant at Anderson Bay has been developed to withstand the worst historic flooding occurrence. Hazard maps developed by the State of Alaska, Division of Geologic and Geodetic Surveys indicate evidence of a 78' run-up from a seismically induced sea wave that occurred along the Anderson Bay shoreline during the 1964 event. Based upon this data, critical facilities will be located at elevations of 100 feet or greater. Liquefaction trains will be located on a bedrock bench at an elevation of 165'. LNG storage tanks will be located on a bedrock bench at an elevation of 100',

and will be further protected by the impoundment dike structures.

It is estimated that combined storm wave and tidal conditions with a 100 year recurrence interval could produce a maximum wave crest elevation of 22' at Anderson Bay. Conceptually defined marine facilities have a 35' planned elevation for tanker berth trestle structures, a 25' planned elevation for the cargo berth structure, and a 30' planned elevation for the off-loading dock area.

The conceptual site layout has been developed to allow multiple routes of access and egress from any facility location during the worst flooding event. The relatively high site elevations eliminate coastal flooding concerns. The relatively steep site topography allows development of drainage controls that preclude surface water flooding concerns.

#### Soil Characteristics

Conceptual definition and layout of the TAGS LNG plant has critical facilities founded on bedrock. On-site geologic reconnaissance indicates that bedrock conditions exist at the locations and elevations proposed for critical facilities siting. The predominately graywacke and interlayered graywacke and phyllite bedrock materials are

expected to offer ample foundation support.

Geotechnical investigations, including detailed geologic mapping, rock core drilling, sampling, groundwater evaluation, and rock quality evaluations, will be conducted during detailed design stages of the project. Foundation design for all LNG facilities will consider maximum static and dynamic loading conditions and appropriate factors of safety.

#### Wind Forces and Other Severe Weather Conditions

Evaluation of historic weather data shows that the TAGS LNG plant can be safely located at Anderson Bay. The facility will be designed and built to withstand, without loss of structural or functional integrity, the worst effects of all weather and natural conditions which may predictably occur at the site.

Wind in the Port Valdez area has been observed at maximum velocities (gusts) on the order of 100 miles per hour. TAGS LNG plant facilities can be designed to withstand effects of wind forces without loss of structural or functional integrity. During detailed design stages of the project, historic wind data will be evaluated using a probabilistic methodology to determine design wind loads. The most critical combination of wind velocity and duration

with respect to structural response will be considered in the detailed design of each LNG facility component.

Port Valdez is a high snowfall area, averaging approximately 300 inches annually. Various methods of snow removal and accumulation control were considered during TAGS conceptual definition. Heat tracing was evaluated for use in prevention of snow accumulation on LNG storage tanks. Mechanical snow removal equipment will be used for maintaining plant roadways and access. TAGS LNG plant facilities can be safely designed, operated, and maintained at the Anderson Bay site in the presence of characteristically large amounts of snowfall. Snowfall will be considered as a significant aspect in plant safety planning during detailed design stages.

Temperatures in the Port Valdez area dip below 0°F approximately 15 days out of each year. The lowest temperature ever recorded in the Port Valdez area is approximately -30°F. TAGS LNG plant facilities can be safely designed, operated, and maintained at the Anderson Bay site during lowest ambient temperatures. Lowest ambient temperatures along with negative thermal flux from stored LNG will be considered in the detailed design of storage tanks.

### Adjacent Activities

Anderson Bay is a relatively remote location within Port Valdez. The distances which separate Anderson Bay from existing development contribute to the inherent safety of the site. Off-site activities will not adversely affect facility integrity, nor will the TAGS LNG plant have adverse impact on the design, operation, and maintenance of off-site activities.

Alyeska Pipeline Service Company owns and operates the Trans-Alaska Pipeline System (TAPS) Terminal at Jackson Point in Port Valdez. The TAPS terminal is located approximately 3 1/2 miles to the east of the proposed TAGS LNG plant site, and is the only existing industrial activity proximate to Anderson Bay. The existence or operations of the TAPS terminal will not adversely affect the operation of the TAGS facility.

The Valdez Narrows, located more than 3 miles west of Anderson Bay, are used by vessel traffic to enter and depart Port Valdez, including tankers which carry TAPS crude oil out of Port Valdez. Major vessel traffic entering the Valdez Narrows travel the length of Port Valdez to access either the TAPS terminal or the city's terminal facility. Shipping use of the Valdez Narrows or Port Valdez will not adversely affect the operation of the TAGS facility.

The City of Valdez is located more than 5 miles east northeast of Anderson Bay on the opposite (north) shore of Port Valdez. No adverse effects to TAGS facility operations will result from the existence or future growth of the City of Valdez. In addition, no adverse effects can be expected from proposed industrial sites located east of Old Valdez and more than ten miles from the Anderson Bay site.

#### Separation of Facilities

Conceptual definition and layout of the proposed TAGS LNG plant facilities has proper facilities separation to allow multiple points of access and egress between any site areas, and to allow personnel and equipment movement around the facility during an emergency. As a minimum, the distances specified in the National Fire Protection Association Code 59-A for Liquefied Natural Gas were used during conceptual layout of facilities.

Using the facilities separation distances developed during conceptual project definition, the TAGS LNG plant can be safely sited at Anderson Bay. Facilities separation distances and optimization of layout will be developed further during detailed design. Preliminary evaluations of

plant thermal and vapor exclusion zones indicate that siting of TAGS LNG plant facilities at Anderson Bay provides an ample land buffer to provide safe conditions outside of the site boundary at all times.

# APPENDIX Y

Yukon Pacific LNG Project,  
Final Environmental Impact Statement  
March, 1995  
(bound copy)

[See Box #3]

The document provided as Appendix Y is the same document provided in Appendix G-10 Binder 5.



# APPENDIX Y

Yukon Pacific LNG Project,  
Final Environmental Impact Statement  
March, 1995  
(bound copy)

[See Box #3]



# APPENDIX Y

## Yukon Pacific LNG Project, Final Environmental Impact Statement March, 1995 (bound copy)

Box 3

### Alaska Gasline Inducement Act License Application

**From:** Alaska Gasline Port Authority  
c/o 731 N Street  
Anchorage, AK 99501

**To:**  
AGIA License Office  
State of Alaska Department of Revenue  
550 West 7<sup>th</sup> Avenue, Suite 1820  
Anchorage, AK 99501

Phone: (907) 269-0080

20 of \_\_\_\_\_

Received "1/31/07 @ 4:38pm - Jv



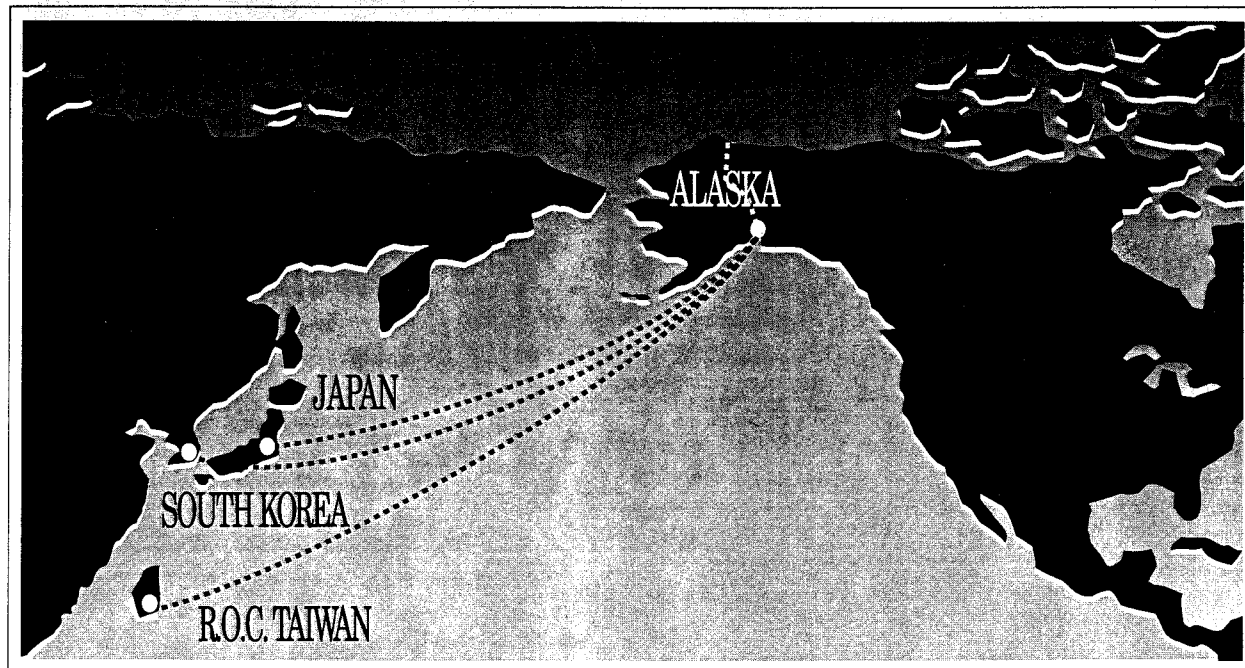
# APPENDIX Z

Trans-Alaska Gas System (TAGS)  
42 inch Right-of-Way Modifications,  
Submission to Joint Pipeline  
Coordinator's Office (JPO)  
October 15, 1992



# Trans-Alaska Gas System (TAGS)

**42 inch Right-of-Way Modifications  
Submissions to the  
Joint Pipeline Coordinator's Office (JPO)**





JEFF B. LOWENFELS  
VICE PRESIDENT

October 15, 1992

Mr. Jerry Brossia  
State Pipeline Coordinator  
Alaska Department of Natural Resources  
411 W 4th Avenue  
Suite 2C  
Anchorage, Alaska 99501

Re: ADL 413342

Dear Mr. Brossia:

Attached you will find the information submitted for the purpose of modifying the Right-of-Way agreement between Yukon Pacific Corporation (YPC) and the State of Alaska Department of Natural Resources (ADNR) for the Trans Alaska Gas Pipeline (TAGS). More specifically, the following three documents have been joined in this binder:

- 1) The **Project Revisions** submitted to the Joint Pipeline Office on July 28, 1992.
- 2) The responses to the **Information Request** dated September 8, 1992. Additionally, informal requests for information since September 8, 1992 have been included here.
- 3) The **42 inch Pipeline Compressor Station Site Selection**, providing additional siting information and site descriptions of the compressor station sites. This document was provided on an informal basis for September 18, 1992 field trip, and is submitted here as the response to informal request #5.

All three of these documents have been combined under a single binder for ease of use and reference.

Please review the new material provided herein and contact us if you have any questions. We stand ready to assist you in every way possible in this modification effort.

Sincerely,

Jeff B. Lowenfels  
Vice President, General Counsel

Attachment



JEFF B. LOWENFELS  
VICE PRESIDENT

October 15, 1992

Mr. David Dorris, Coordinator  
Bureau of Land Management  
Pipeline Coordinator's Office  
411 W 4th Avenue  
Suite 2C  
Anchorage, Alaska 99501

Re: Right-of-Way Grant, F-83941 & AA-53559

Dear Mr. Dorris:

Attached you will find the information submitted for the purpose of modifying the Right-of-Way agreement between Yukon Pacific Corporation (YPC) and the State of Alaska Department of Natural Resources (ADNR) for the Trans Alaska Gas Pipeline (TAGS). More specifically, the following three documents have been joined in this binder:

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Sincerely,

Jeff B. Lowenfels  
Vice President, General Counsel

Attachment





**YUKON  
PACIFIC  
CORPORATION**  
TRANS-ALASKA GAS SYSTEM

JEFF B. LOWENFELS  
VICE PRESIDENT

July 28, 1992

Mr. Jerry Brossia  
State Pipeline Coordinator  
Department of Natural Resources  
411 West 4th Avenue  
Suite 2C  
Anchorage, Alaska 99501

Re: ADL 413342

Dear Mr. Brossia:

Attached is a description of the revisions to the Trans-Alaska Gas System as a result of the decision to increase pipe diameter to 42 inches.

Please review and contact us concerning the changes described in the attachment. We stand ready to assist you every way possible in this modification effort.

Sincerely,

Jeff Lowenfels  
Vice President - General Counsel

attachment



**YUKON  
PACIFIC  
CORPORATION**  
TRANS-ALASKA GAS SYSTEM

JEFF B. LOWENFELS  
VICE PRESIDENT

July 28, 1992

Mr. David Doris  
Coordinator  
BLM Pipeline Coordinator's Office  
411 West 4th Avenue  
Suite 2C  
Anchorage, Alaska 99501

Re: Right-of-way grant F-83941 & AA-53559

Dear Mr. Doris:

Attached is a description of the revisions to the Trans-Alaska Gas System as a result of the decision to increase pipe diameter to 42 inches.

Please review and contact us concerning the changes described in the attachment. We stand ready to assist you every way possible in this modification effort.

Sincerely,

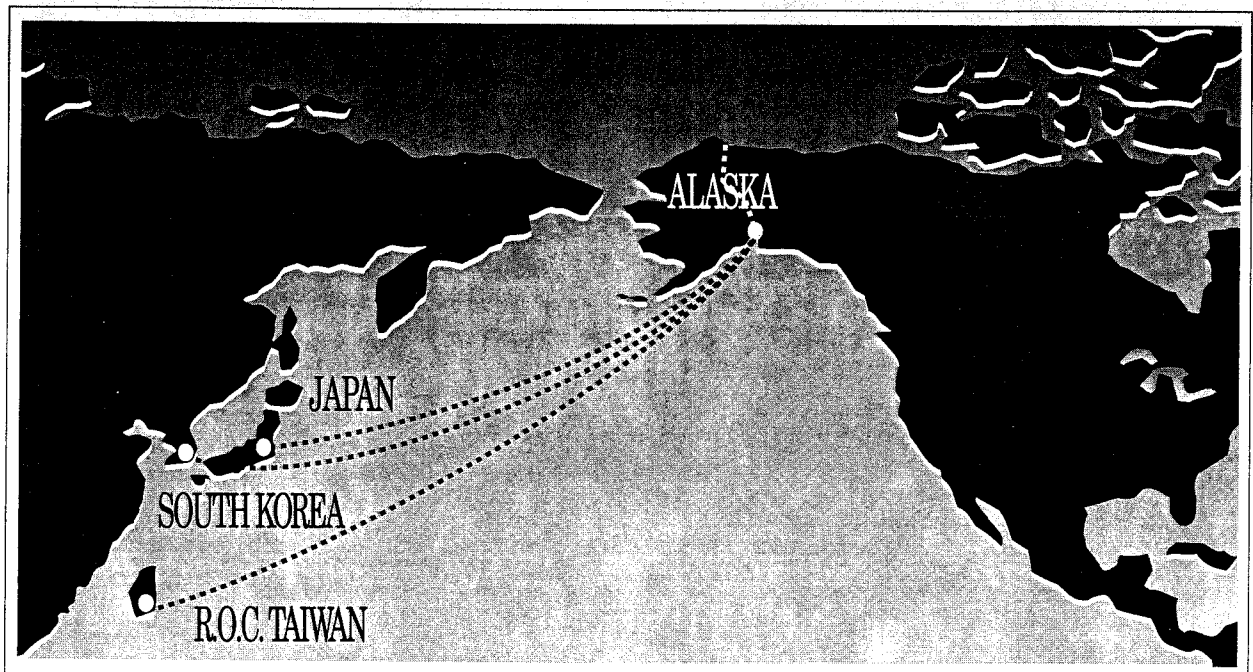
Jeff Lowenfels  
Vice President - General Counsel

attachment



# Trans-Alaska Gas System (TAGS)

## PROJECT REVISIONS



# Yukon Pacific Company L.P.

## Revisions to the Trans-Alaska Gas System

### *Preface*

Yukon Pacific Company L.P. (YPC) has increased the diameter of the Trans-Alaska Gas System (TAGS) mainline. Additionally, YPC has incorporated a phased ramp-up to full volume over five years at the beginning of the project. These actions modify the project description and the impacts of the proposed action. The resulting modifications are described in this document and the attached drawings.

### *Modifications to the Project Description*

#### Line Pipe Diameter and Wall Thickness Modifications

A 42 inch outside diameter line pipe has been selected based upon recent optimization studies. This represents an increase of six inches over the original 36 inch diameter line pipe. X-80 line pipe remains the steel grade of choice for the unchanged 2,220 psi maximum allowable operating pressure.

The larger pipe diameter requires changes to the wall thickness. The new values, with their corresponding Department of Transportation class locations and design safety factors, are presented in Table 1.

Table 1  
Pipe Wall Thickness vs. Class Location  
(X-80 Grade Steel, 2220 psig Maximum Operating Pressure)

Class Location	Design Factor	Pipe Wall Thickness (Inches)
1	0.72	0.809
2	0.60	0.971
3	0.50	1.166
4	0.40	1.457

#### Compressor Stations

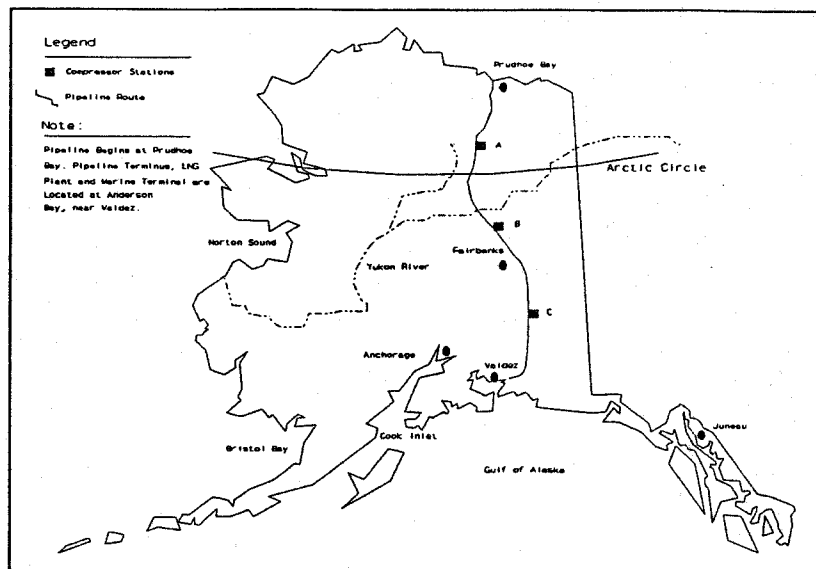
The number of compressor stations, their locations and the timing of their installation have

changed as a result of the pipeline diameter increase. Figure 1 is a system map identifying the system and general layout of the compressor stations along the pipeline route.

### Reduced Number of Stations

The increase in pipeline diameter reduced the compression requirements of TAGS. As a result, only three compressor station sites (Sites A, B and C, as shown in Figure 1) are required to achieve 14 Million Metric

Tons per Year (MMTPY) of LNG production. The station locations were selected based upon hydraulic efficiency, then adjusted to optimize geotechnical, environmental or other area-specific considerations.



**Figure 1 - Trans-Alaska Gas System Pipeline Overview**

### Deferred Installation of Compressor Stations

The phased ramp-up to 14 MMTPY delays the need for compression until after the pipeline is operational. The schedule shown in Figure 2 identifies when compressor stations are mechanically complete for operation, based upon Liquefied Natural Gas (LNG) exports increasing at the rate of 3 MMT annually. Station B would be the initial station and would not be required until exports reach 9 MMTPY. This is followed by compressor stations A and C, which will enable export of 14 MMTPY.

### Identification of New Compressor Station Locations

The following is a description of the revised compressor station locations. The locations are further identified on the attached drawings from Drawing Series TAGS-01, Revision 2.

#### Compressor Station Site A

Compressor station site A is located at MP 190.0 of the TAGS pipeline. The site is 11.5 miles north of the Dietrich Airport and approximately 1000 feet east of the Dalton Highway, well above the normal floodplain of the Dietrich River valley. The area geology consists of apparent bedrock outcrops. (Land Status - Federal/State Selected)

### Compressor Station Site B

Compressor station site B is located at MP 392.4 of the TAGS pipeline, within the Livengood Uplands of the Interior Province. The Livengood Uplands are characterized by rolling hills and dense black spruce. The site is atop a hill approximately 1.5 miles NW of the old Livengood camp site used during construction of TAPS. The TAPS right-of-way boundary forms the SW border of the compressor station site. Soil conditions at the site are characterized by well drained frozen bedrock. (Land Status - State of Alaska)

### Compressor Station Site C

Compressor station site C is located at MP 568.0 of the TAGS pipeline within the Delta River lowland of the Alaska Range Province. The site is 5 miles north of the U.S. Army's Black Rapids Training Facility, 12 miles north of TAPS pump station No. 10 and uphill from the Richardson Highway, TAPS and Delta River drainage. The site geology consists of shallow bedrock covered by till. (Land Status - State of Alaska)

### Reduced Horsepower Requirements

The transmission efficiencies of a larger pipeline dramatically reduce the horsepower required to transport natural gas sufficient to produce 14MMTPY of LNG. Table 2 shows the required horsepower.

**Table 2**  
**42 inch Pipeline Horsepower Requirements\***

Compressor Station Site	Compression Horsepower (BHP)	(C) Cooling\ (H) Heating Requirements
A	36,000	(C) 13,400 BHP
B	25,000	(C) 10,000 BHP
C	25,000	(H) 148 MMBTU/Hr
<b>Total</b>	<b>86,000</b>	<b>N/A</b>

\* Exclusive of Compression Requirements at Prudhoe Bay  
(BHP) - Brake Horsepower    MMBTU/Hr - Millions of BTU's per Hour

This represents a reduction of 160,000 BHP from compression requirements for the 36 inch

system<sup>1</sup> and a reduction of approximately 16,600 BHP for gas cooling requirements<sup>2</sup>.

### **Pipeline Route Adjustments**

TAGS was rerouted between MP 566.6 and MP 571.5 to facilitate the new location of compressor station site C. This reroute is on land owned by the State of Alaska.

The reroute begins at MP 566.6 and immediately crosses TAPS to the east. After crossing TAPS, TAGS parallels the Richardson Highway approximately 300 feet from TAPS for 0.5 miles and then crosses the highway to reach the new Compressor Station No. 6 site at MP 568.0. Coming out of Compressor Station No. 6, TAGS crosses Darling Creek and heads south, 200 feet uphill from TAPS, until reconnecting with the old route at MP 571.5.

The reroute moves one Richardson Highway and one TAPS crossing farther north. The reroute did not add or subtract any appreciable length to the TAGS pipeline. The attached drawing illustrates this routing adjustment.

## ***Modifications to the Impacts of the Proposed Action***

### **Project Construction Requirements**

#### **Project Construction Schedule**

Figure 2 shows the revised schedule for construction of the TAGS Project. Changes to the original project schedule are the delayed construction of the compressor stations and some of the process trains located at the LNG/MT. The increase in pipeline diameter to a 42 inch does not adjust the timing or duration of the pipeline construction effort.

#### **Construction Manpower Requirements**

The projected manpower requirements to construct TAGS have been adjusted. This adjustment is based on the increased effort required for the 42 inch pipeline and the deferred efforts associated with the compressor stations and LNG process trains. Table 3 shows the project employment in Alaska (By Job Type - Construction Phase) for the modifications. These modifications lower peak manpower requirements and extend the construction period.

---

<sup>1</sup> See Response 22-6, page 7-143, (identifying 246,000 BHP for the five station configuration) of the Trans-Alaska Gas System Final Environmental Impact Statement (BLM-AK-PT-88-003-1792-910), issued June 1988.

<sup>2</sup> Reference Table 2.2.1-2, page 2-6 of the Trans-Alaska Gas System Final Environmental Impact Statement (BLM-AK-PT-88-003-1792-910), issued June 1988. An estimate of 10,000 BHP per station was assumed for cooling at four stations, with warm gas operation after the fifth station (no chiller).



Table 3

## TAGS Project Employment in Alaska

## By Job Type - Construction Phase

YEAR	-4	-3	-2	-1	Start-Up	+1	+2	+3
JOB TYPE								
Construction Managers	1	12	55	56	54	4	5	5
Administrative Managers	1	12	55	56	54	4	5	5
Engineers	3	36	157	160	140	10	13	14
Engineering Technicians	1	21	34	63	43	4	5	5
Computer Technicians	1	21	34	63	43	4	5	5
Attorneys	1	8	15	16	16	4	5	5
Life & Physical Scientists	1	12	18	19	14	4	5	5
Public Relations	1	8	15	16	16	4	5	5
Labor Relations	1	12	41	42	31	4	5	5
Purchase Agents	1	21	34	28	19	4	6	5
Accountants	1	12	21	22	19	4	5	5
Bookkeepers	1	12	21	42	43	3	5	5
Secretaries	1	12	55	56	43	4	9	5
Data Entry Personnel	1	12	55	56	43	4	8	5
Clerks	1	12	55	63	43	4	5	5
Carpenters	3	89	239	96	114	10	10	14
Caterers	5	57	207	395	310	22	26	24
Concrete Workers	5	42	226	512	331	26	30	21
Electricians	5	60	205	381	272	21	26	24
Sheet Metal Workers	7	57	178	261	234	25	32	20
Laborers	19	241	1060	1423	1208	76	92	101
Operating Engineers	5	131	533	655	475	22	29	38
Painters	4	30	69	243	161	13	16	17
Pipe Fitters	7	92	226	424	182	28	31	22
Welders	10	137	621	678	662	45	67	55
Teamsters	15	167	671	818	1026	58	66	57
TOTAL WORK FORCE	104	1,324	4,900	6,641	5,594	413	516	472
Grand Total Man								19,964

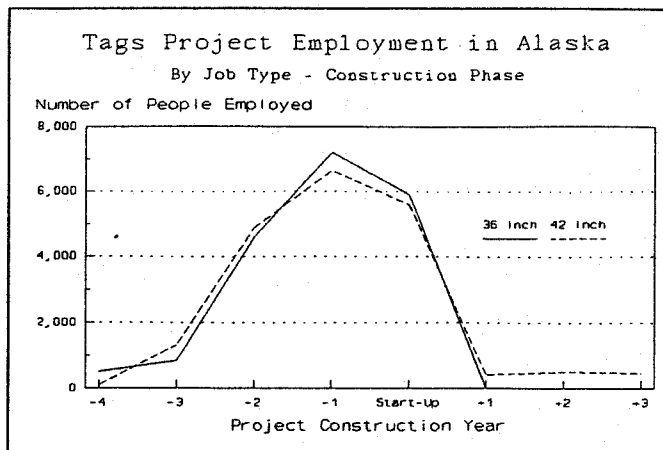
The number of construction camps, and their locations, do not change from the original 36 inch project scope.

## **Land Use**

The increase to a 42 inch pipeline adjusts the land use requirements of TAGS for a variety of direct and indirect reasons.

### **Increase in Pipeline Diameter**

The right-of-way agreements between YPC and the Bureau of Land Management (BLM) (Serial Numbers F-83941 and AA-53559), and the State of Alaska (ADL 413342) identifies the pipeline right-of-way as 50 feet plus the width of the pipeline. The 36 inch pipeline right-of-way width was 53 feet. The increase to a 42 inch pipeline will increase the right-of-way width by 6 inches to 53.5 feet. This is an increase of 48.3 acres of land for accommodation of the 42 inch pipeline, based upon 796.5 mile length of the pipeline route.



**Figure 3 - Manpower Requirements**

### **Reduction in Number of Compressor Station Sites**

Land use for the compressor stations has been reduced due to the reduction in the number of compressor stations. The location of the new compressor stations, along with the projected land use, is identified in Table 4.

The total change in compressor station construction acreage between the previous 10 station configuration<sup>5</sup> and the three station configuration is a reduction of 188 acres.

### **Acreage Adjustments due to Route Adjustments**

The reroute for Compressor Station No. 6 did not add appreciable acreage to TAGS.

### **Net Adjustments in Land Use for TAGS**

Net effect on land use is a decrease of 139.70 acres (Federal, -138.72 acres; Federal/State Selected, -60 acres; State, +53.73 acres; Private, +4.83 acres; adjustments are approximate).

<sup>5</sup> Reference table 2.2.1-2, page 2-6, of the Trans-Alaska Gas System Final Environmental Impact Statement (BLM-AK-PT-88-003-1792-910), Issued June 1988.

**Table 4**  
**New Compressor Station Site Acreage**

Compressor Station	TAGS Milepost	Construction Acreage	Operation Acreage
A	190.0	30	20
B	392.4	30	20
C	568.0	30	20
TOTALS		90	60

### **Borrow Material Requirements**

Borrow material, or mined gravel requirements for TAGS construction, are adjusted for the changes shown below.

### **Ditch Configuration/Select Backfill Requirements**

The estimated borrow material requirements for select ditch backfill was 3.3 million banked cubic yards<sup>6</sup> (BCY). The 42 inch pipeline will require an increase in select backfill of approximately 15.8%. This increase translates to an additional 521,400 BCY. The total select backfill requirements is estimated at 3.8 million BCY for the 42 inch pipeline.

### **Access Roads, Workpads**

It is anticipated that no additional borrow material will be required for access roads or workpads as a result of increasing the pipe diameter to 42 inches.

### **Due to Reduction of Compressor Stations**

The reduction number of compressor stations required for the 42 inch pipeline reduces associated borrow material requirements. The new requirements are presented in Table 5.

---

<sup>6</sup> Reference Table 2.3.2-1, page 2-23 of the Trans-Alaska Gas System Final Environmental Impact Statement (BLM-AK-PT-88-003-1792-910), issued June 1988.

**Table 5**  
**Compressor Station Sites**  
**Projected Borrow Material Requirements**

Compressor Station	Borrow Material (BCY)
A	200,000
B	150,000
C	150,000
TOTAL	500,000

BCY = Banked Cubic Yards

The 10 compressor station configuration for 36 inch system was projected to require 2,300,000 BCY of borrow material<sup>7</sup>. The three compressor station configuration for the 42 inch will reduce compressor station borrow material requirements by 1,800,000 BCY.

#### **Net Adjustment in Borrow Material Requirements**

Net effect on Borrow Material requirements is a decrease of 1,278,600 BCY when compared to previous estimates<sup>8</sup>.

#### **Air Quality**

The emissions resulting from TAGS are reduced by the modifications.

#### **Construction Emissions**

Construction exhaust emissions from TAGS slightly increase as a result of these modifications. However, the increase is considered negligible. The increase is due to the additional construction activity for the larger pipeline, partially offset by the reduction in the number of compressor stations required.

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<sup>7</sup> Reference Table 2.4-1, page 2-48 of the Trans-Alaska Gas System Final Environmental Impact Statement (BLM-AK-PT-88-003-1792-910), issued June 1988.

<sup>8</sup> Reference Table 2.3.2-1, page 2-23 of the Trans-Alaska Gas System Final Environmental Impact Statement (BLM-AK-PT-88-003-1792-910), issued June 1988.

## **Operation Emissions**

Emissions which result from TAGS operations are reduced due to the reduction in pipeline compression and cooling horsepower requirements. Emissions identified for the 36 inch pipeline system<sup>9</sup> were reduced 41% for the 42 inch pipeline configuration, based on comparison of horsepower requirements.

## **Wildlife/Habitat**

The reduction and relocation of the compressor stations has eliminated two habitat concerns identified for the previous 10 station configuration. The new compressor station sites are not located in any known critical habitat areas.

### **Old Compressor Station No. 1**

The old compressor station No. 1 site, located at Milepost 67.5 of the TAGS pipeline (Federal Land), was near the Sagwon Bluffs Area of Critical Environmental Concern and within the 2 mile radius of existing peregrine falcon nests<sup>10</sup>. The elimination of this station site removes this interference.

### **Old Compressor Station No. 9**

The old compressor station No. 9 site, located at Milepost 640.5 of the TAGS pipeline (State Ownership), was located in an area known as the Hogan Hill area. This site caused interference with the migration patterns of the Nelchina caribou herd in their movement from winter range to summer range during spring and early winter. The elimination of this station site removes this interference.

## **Liquid, Solid and Hazardous Wastes**

### **Liquid Wastes**

Wastewater from construction camps increases slightly due to the increased effort for pipeline construction. This increase is partially offset by the reduced construction requirements for compressor stations. Water used for hydrostatic testing increases due to the larger diameter pipeline.

---

<sup>9</sup> See Footnotes 2 and 3.

<sup>10</sup> Reference paragraph 6 of Section 4.2.13.3.1, page 4-71 and Section 4.2.19.2, page 4-97 of the Trans-Alaska Gas System Final Environmental Impact Statement (BLM-AK-PT-88-003-1792-910), issued June 1988.

Wastewater from operations is associated with the operation of the compressor stations. This volume is reduced due to the reduction in the number of compressor stations.

Any wastewater streams from these sources will require a state discharge permit prior to release. The released water will adhere to Alaska Department of Environmental Conservation regulations for water quality.

### **Solid Wastes**

Solid wastes from construction are primarily generated from construction camps at the rate of about 8 pounds per day per person<sup>11</sup>. The total volume of solid waste would increase proportionately to the increased labor requirements for construction of the pipeline. This is partially offset by the reduced effort for the compressor stations.

Solid wastes from operations would be reduced. It is estimated that solid wastes generated at compressor stations range from 50 to 150 pounds per day<sup>12</sup>. This volume of solid waste would be reduced proportional to the reduction in the number of compressor stations.

### **Hazardous Wastes**

The hazardous and toxic materials used during construction include a multitude of various compounds<sup>13</sup>. The use of these materials will increase proportionately with the increased overall construction effort. The following tables recap the hazardous materials involved in the operation of the compressor stations. Generally speaking, the consumption and storage requirements is reduced proportionately to the reduction in the number of compressor stations.

---

<sup>11</sup> Reference Section 4.2.7.3, first paragraph, page 4-34 of the Trans-Alaska Gas System Environmental Impact Statement (BLM-AK-PT-88-003-1792-910), issued June 1988.

<sup>12</sup> Reference Section 4.2.7.3, first paragraph, page 4-34 of the Trans-Alaska Gas System Environmental Impact Statement (BLM-AK-PT-88-003-1792-910), issued June 1988.

<sup>13</sup> A comprehensive listing of hazardous and toxic materials to be stored, handled and used during construction can be found in Section 4.2.7.4, first paragraph, page 4-35 of the Trans-Alaska Gas System Environmental Impact Statement (BLM-AK-PT-88-003-1792-910), issued June 1988.

**Table 6**  
**Estimated Quantities of Hazardous Materials Stored, Handled, or Consumed**  
**for the TAGS compressor Stations**

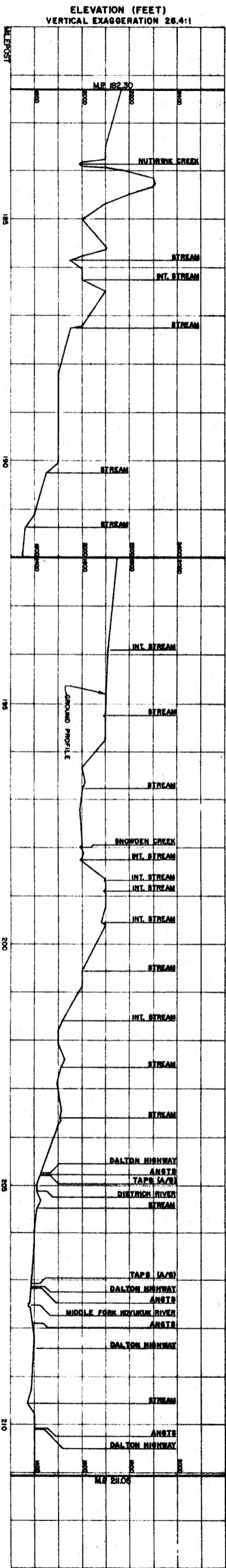
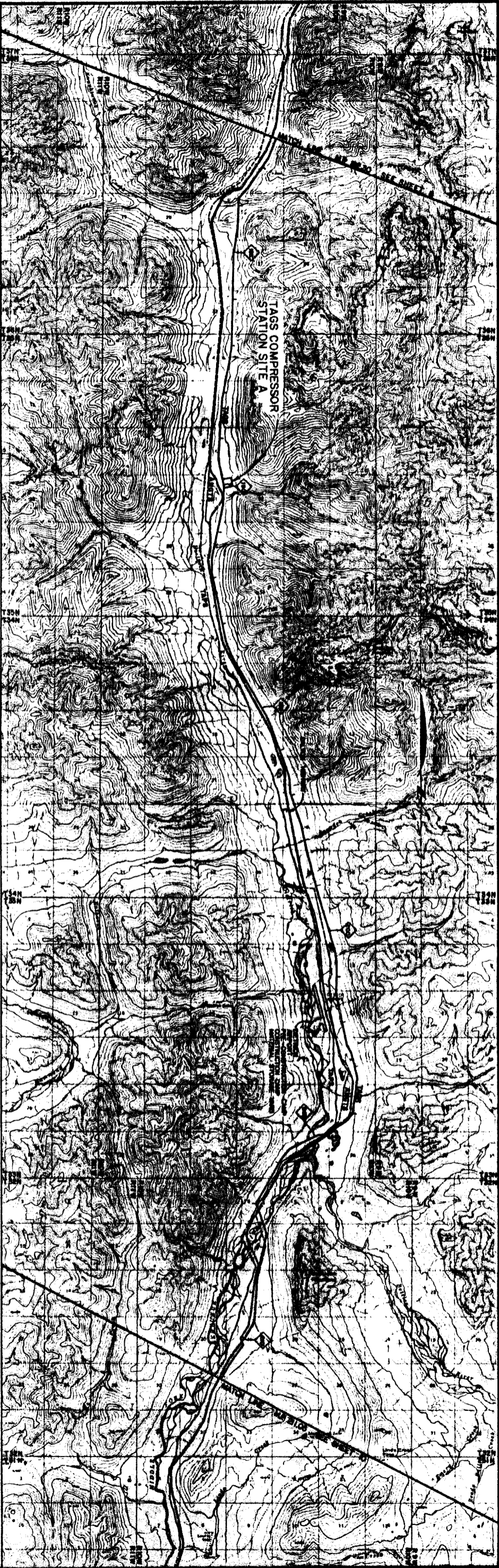
Description	Monthly Consumption	Storage Volume	Remarks
Nitrogen	1,125 scf*	2,250 scf	250 scf bottles @ 2,200 psig, 3 bottles per station
Bearing Oil	-0-	360 gallons	120 gallons synthetic oil per station
Seal Oil	165 gallons	1,650 gallons	Stored in 55 gallon drums
Fire Suppression	-0-	1,800 pounds	Inert Gas (Halon Equivalent) in 300# cylinders
Ethylene Glycol	20 gallons	220 gallons	Stored in 55 gallon drums
Propane	-0-	7,500 gallons	Refrigerant gas; 2500 gallon storage per station
Diesel	6,900 gallons	120,000 gallons	40,000 gallon tank @ station
Gasoline	1,800 gallons	15,000 gallons	5,000 gallon tank @ station

\* scf - Standard Cubic Feet

**Table 7**

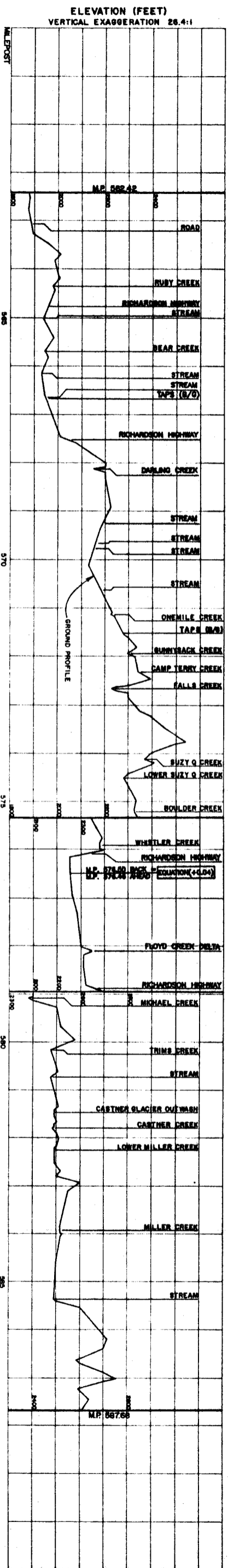
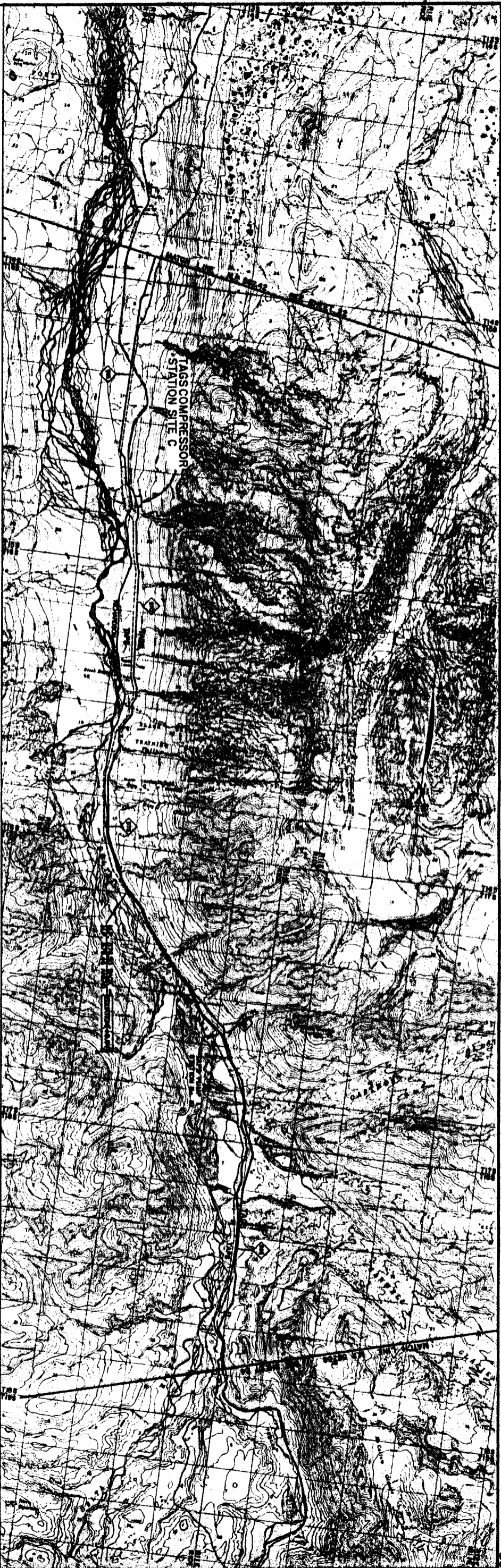
**Chemicals and other Hazardous Materials stored at the Central Maintenance Facility**

Bearing Oil	4,300 gallons (one reservoir replacement)
Seal Oil	1,200 gallons
Fire Suppression	5,000 pounds (one total system replacement)
Propane	Refrigerant make-up will be accommodated out of LNG/MT storage



BASE SHEET REVISIONS		NOTES	
NO.	DATE	BY	DATE
1	10/1/05	W. J. HARRIS	10/1/05
FEDERAL R.O.W. GRANT - EXHIBIT A			
BLM SERIAL NO.'S 4453893 & 4738841			
STATE R.O.W. LEASE (CONDITIONAL) - EXHIBIT C			
BLM NO. 413345			
COW 05			
2. 2001 MODIFICATION FOR 42" O.D. PIPELINE			
This document and the data and information upon which it is based is confidential and proprietary to the Yukon Pacific Corporation and neither the document nor the information upon which it is based shall be duplicated, used, or disclosed except as authorized in writing by Yukon Pacific Corporation.			
USGS MAPS CHANDALAR C-6-D-6		YUKON PACIFIC CORPORATION TRANS-ALASKA GAS SYSTEM	
PRUDHOE BAY TO PORT WALDEZ 42" O.D. NATURAL GAS PIPELINE MILEPOST 182.30 TO 211.05		SCALE: H = 1 INCH HORIZ., V = 26.4 VERT. DATE: FEB. 1, 1995	
DRAWN BY: W. J. HARRIS CHECKED BY: W. J. HARRIS DATE: 10/1/05		DRAWN BY: W. J. HARRIS CHECKED BY: W. J. HARRIS DATE: 10/1/05	





NO.	DATE	BASE SHEET REVISIONS	BY	DATE	REVISION	DATE
0	5/6/00	FEDERAL ROAD DISTRICT - EXHIBIT A	LIB			
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U.S.G.S. MAPS  
MT. HAYES B-4, C-4  
COMPOSITE INDEX

YUKON PACIFIC CORPORATION  
TRANS-ALASKA GAS SYSTEM

PRUDHOE BAY TO PORT WALDEZ  
42" O.D. NATURAL GAS PIPELINE  
MILEPOST 562.42 TO 567.66  
SCALE 1" = 1 MILE HORIZ. 1" = 200 VERT.  
DATE FEB. 1, 1984  
SHEET 23 OF 21





**YUKON  
PACIFIC  
CORPORATION**  
TRANS-ALASKA GAS SYSTEM

JEFF B. LOWENFELS  
VICE PRESIDENT

October 15, 1992

Mr. Jerry Brossia  
State Pipeline Coordinator  
Alaska Department of Natural Resources  
411 W 4th Avenue  
Suite 2C  
Anchorage, Alaska 99501

Re: ADL 413342

Dear Mr. Brossia:

The following represents responses to the questions submitted by the Joint Pipeline Coordinator's Office (JPO) on September 8, 1992 (attached).

Please review and contact us concerning the responses provided or any other questions you may have.

Sincerely,

Jeff B. Lowenfels  
Vice President, General Counsel

Attachment

210091.02.JDS



**YUKON  
PACIFIC  
CORPORATION**  
TRANS-ALASKA GAS SYSTEM

JEFF B. LOWENFELS  
VICE PRESIDENT

October 15, 1992

Mr. David Dorris, Coordinator  
Bureau of Land Management  
Pipeline Coordinator's Office  
411 W 4th Avenue  
Suite 2C  
Anchorage, Alaska 99501

Re: Right-of-Way Grant, F-83941 & AA-53559

Dear Mr. Dorris: *PAVED*

The following represents responses to the questions submitted by the Joint Pipeline Coordinator's Office (JPO) on September 8, 1992 (attached).

Please review and contact us concerning the responses provided or any other questions you may have.

Sincerely,

*Jeff Lowenfels*  
Jeff B. Lowenfels  
Vice President, General Counsel

Attachment

21009L02.JDS

STATE OF ALASKA

WALTER J. HICKEL, GOVERNOR

**STATE PIPELINE COORDINATOR'S OFFICE**

- ☐ Department of Environmental Conservation
- ☐ Department of Natural Resources
- ☐ Department of Fish and Game

411 WEST 4th AVENUE, SUITE 2C  
ANCHORAGE, ALASKA 99501  
PHONE: (907) 278-8594  
(907) 278-8595  
FAX: (907) 272-0690

Letter # 92-051-M  
File code (52)1  
TAGS.1404  
.0102

September 8, 1992

John Swanson  
Yukon Pacific Corporation  
1049 West 5th Avenue  
Anchorage, AK 99501-1930

Dear Mr. Swanson:

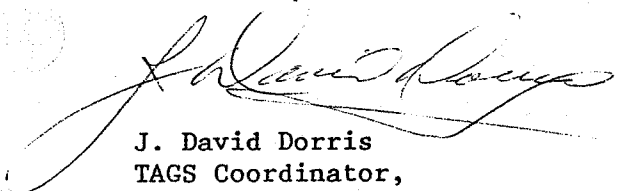
As a result of our meeting on August 24, we are submitting the following list of questions for your attention and response:

1. Please provide three sets of aerial photography for the new compressor sites.
2. Identify the size of the buildings and improvements to be contained within each site, i.e. a site plan.
3. Provide the number and size of turbines, gas compressors, refrigeration compressors, heaters, relief systems proposed for each station, and any additional equipment that may impact air quality.
4. Provide the calculated amount of particulate matter and exhaust emissions resulting from each station.
5. Identify the location of borrow sites to be used for the construction of each station.
6. Will the design changes cause changes in the location of the proposed communication system?
7. Are there any other alignment changes since the original application that are not portrayed on the 3 plats?
8. Please provide an evaluation of noise levels associated with the design changes.
10. Will the number of mainline block valves change?

11. Is it possible to adjust the location of the compressor stations? If so, how much and what criteria should be used?
12. Are there any geologic hazards associated with compressor station number 3?
13. What is the projected increase in ditch size and disposal requirements for unsuitable material?
14. Per our discussion please provide additional detail on the work force/work effort needed for the revised project and compare with the original proposal.
15. How will the effects of frost bulb formation in streams be evaluated and mitigated if different for the 42 inch line?
16. The JPO and YPC have not agreed upon certain segments of the pipeline alignment (Galbraith Lake, Summit Lake, Atigun Pass, Keystone Canyon, Canyon Slough). Will changes in the alignment preferred by YPC result in changes to the compressor station locations now proposed by YPC?

Thank you for your attention to this information request.

Sincerely,

  
J. David Dorris  
TAGS Coordinator,  
Joint Pipeline Office

*John  
Sorry this is so late. I got hung up on "a" and -  
JP*

*MultiDex™*

**Wilson Jones.**

### *JPO Question #1*

*Question: Please provide three sets of aerial photography for the new compressor sites.*

#### *YPC Response:*

Three sets of 1:36,000 B&W aerial photography, sufficient to obtain a full stereo image of each compressor station site, have been assembled and are placed in the envelope attached to this submittal marked JPO 1-1: aerial photography.

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**Wilson Jones.**

## *JPO Question #2*

**Question:** *Identify the size of the buildings and improvements to be contained within each site, i.e. a site plan.*

### **YPC Response:**

Initial preparation of the compressor station sites will take place during civil grading. At all three stations it is anticipated that bedrock, overlain by residual soils, will be encountered at shallow depths. In these instances pads can be constructed over the bedrock after initial grading.

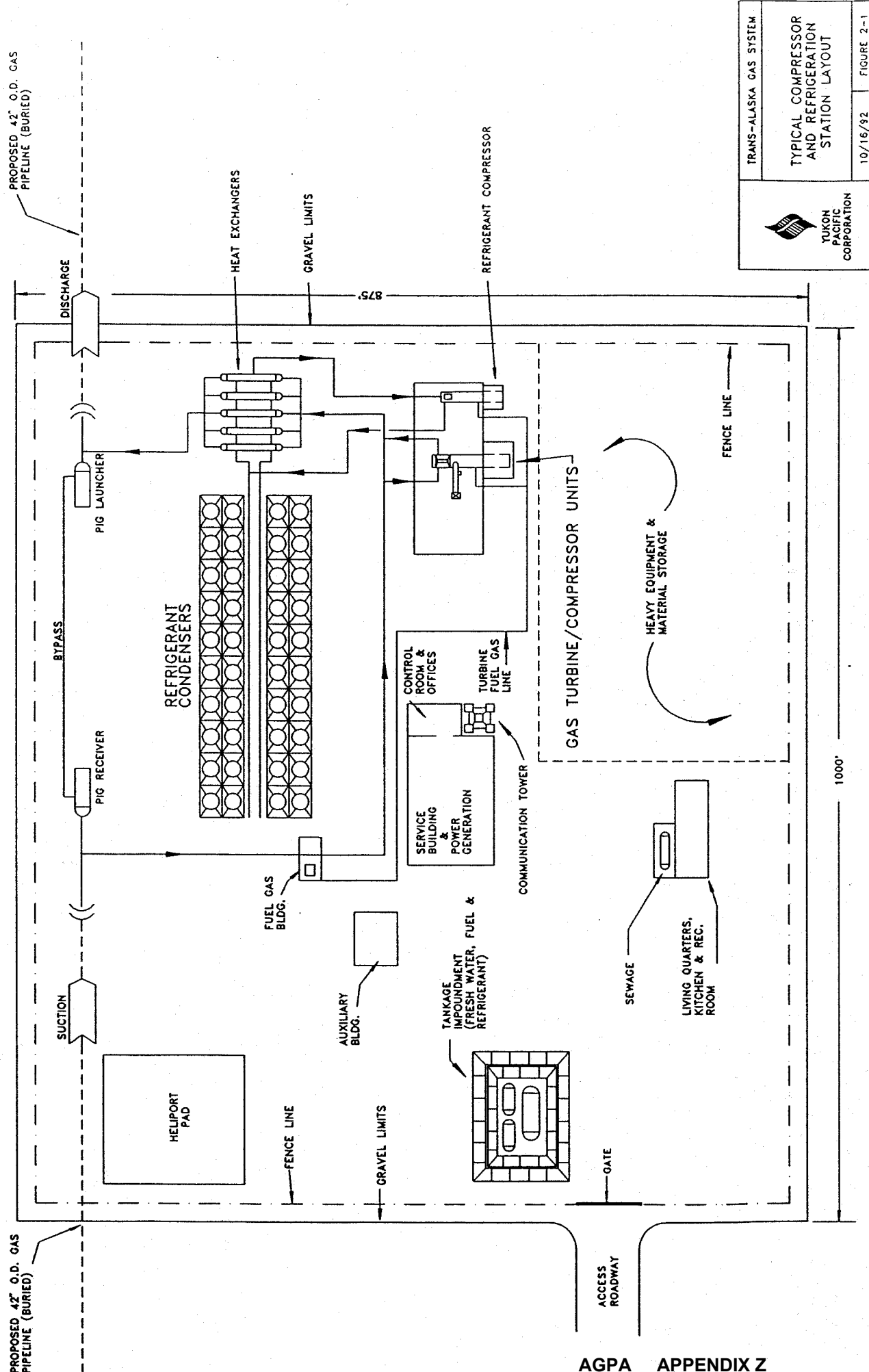
Gravel pads at each compressor station site will be of uniform thickness with a slight slope to the area perimeter to provide drainage for precipitation and snow-melt. Gravel pads will vary in thickness from site to site depending upon geotechnical, climatic and ground thermal conditions. Material used for pad construction will be non frost-susceptible sand and gravel.

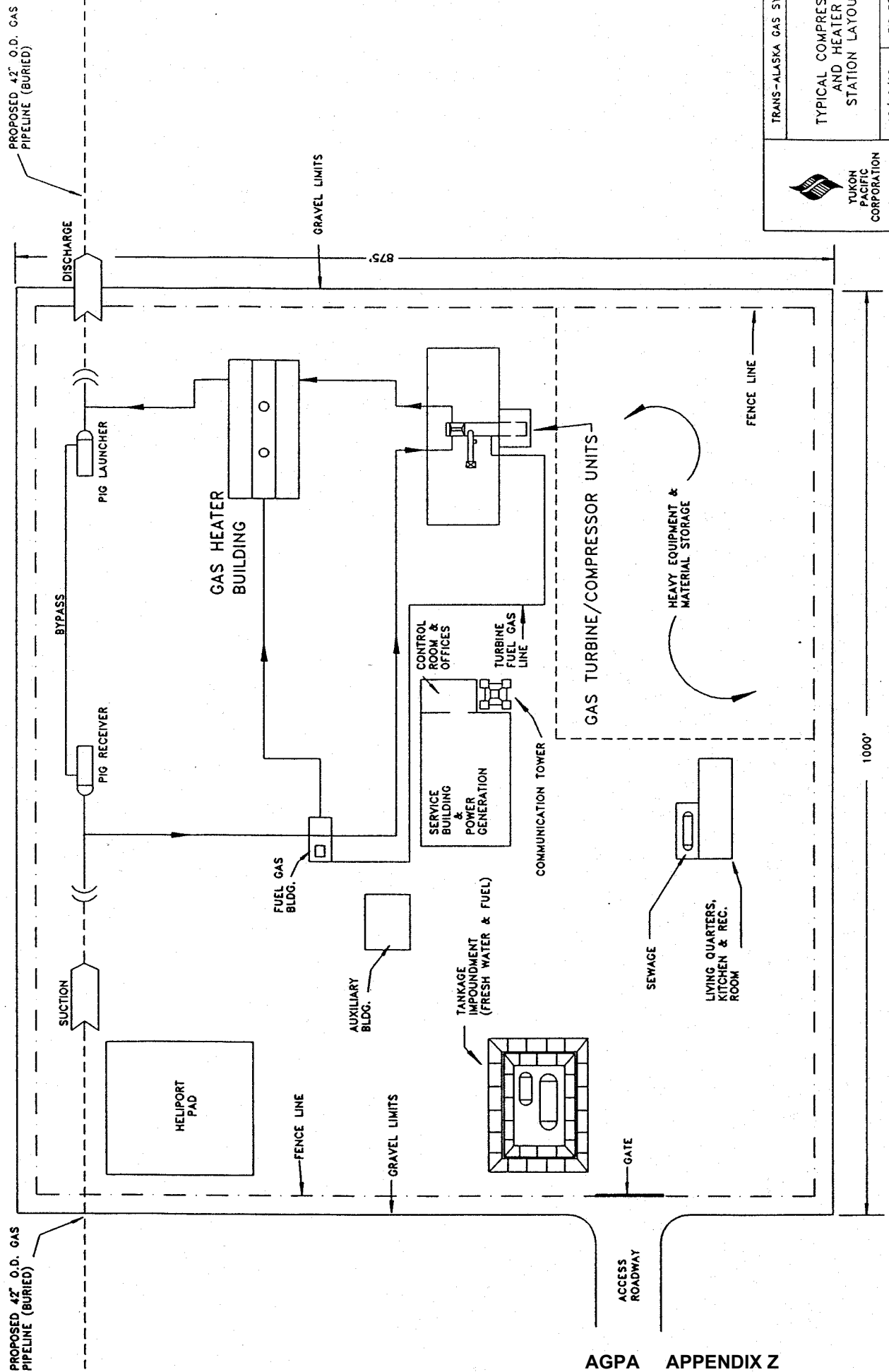
Approximately 20 acres are required for development of the proposed station layout. Moderate grade roadway access to the site will be required for hauling modules during construction. Reasonable proximity to the existing haul road is desirable to minimize new road construction. The overall dimensions of the facility may vary slightly to best fit the local terrain.

Each of the compressor stations will have compressor facilities, refrigeration facilities, maintenance facilities, communication facilities, life support facilities for personnel, utility systems sufficient for stand-alone operation, and storage facilities. Figure 2-1, taken from the December 1986, Trans-Alaska Gas System Project Description, identifies the approximate size, number, and locations of buildings and/or improvements within a typical compressor station. Figure 2-2 shows a compressor station layout with a heater in place of the refrigeration condensers and heat exchangers.

At each compressor station, incoming gas will move through the incoming station block valve and pig receiver to a separation vessel (if required) to remove any liquid or other impurities that may affect compressor operation. Mainline gas is then compressed to maximum allowable operating pressure by turbine driven centrifugal compressors. The turbine driven units are fueled by pipeline gas which is taken off of the gas throughput stream, and metered prior to utilization.

Where pipeline design requires chilled gas operation, refrigeration is provided to remove the heat of compression. Refrigeration is accomplished by compressing, condensing, and circulating an external refrigerant gas to chill flowing mainline gas through use of exchangers.





Installation of a gas heating unit will be an option for maintaining pipeline gas design temperatures. Because the pipeline gas cools as a result of pressure loss along the pipeline, relatively cold gas temperatures may develop at downstream portions of the pipeline between compressor stations. Where both frost susceptible soil conditions, and low pipeline operating temperatures are indicated, heater units will be considered as an optional design for frost-heave mitigation.

TAGS compressor stations will include on-site utility systems for air supply, water supply, fuel storage, effluent treating, electric power, emergency power and glycol heating. Instrument and utility air systems are supplied by air compressor equipment. A dry, conditioned air supply at a pressure of 100 psi will satisfy control and maintenance needs.

A water storage tank will provide domestic and fire water supplies. It is estimated that approximately 50,000 gallons of water storage will be required. System resupply will be by tank-truck hauling, if local supplies are not available.

Gasoline fuel storage will be provided for vehicles. Diesel fuel storage will be provided for emergency power generation backup. It is estimated that a 5,000 gallon gasoline storage tank, and a 40,000 gallon diesel fuel storage tank will satisfy the requirements of each station. Fuel storage tanks will be constructed aboveground within impervious diked containment structures.

A 2500 gallon tank will be required for storage of propane refrigerant make-up. This tank will be installed within the diked containment structure.

Sanitary wastes will be collected by a vacuum system and stored in on-site tanks. Periodically, the tanks will be emptied by vacuum tank trucks for offsite treatment and proper disposal. Underfloor or similarly placed sumps will be provided to collect minor spills, including oils, solvents and water. Vacuum trucks will empty these sumps as required.

The electrical system at each compressor station will be designed for continuous and reliable service. Each station will have its own power generation and distribution system. Dual fuel (natural gas or diesel) generators will supply station power requirements. Based upon conceptual design, it is estimated that a 4,000 kilowatt generator will satisfy operating requirements at each station.

An uninterruptible battery power supply system will be provided for controls, communications, lighting and other emergency and life support systems at each compressor station. This emergency power system will automatically activate if power generation equipment is unable to function.

Dual fuel-fired heaters with circulating glycol/water medium will be provided for space heating and fuel gas preheating.

Support facilities at each compressor station include buildings, permanent housing, a helicopter pad and various mobile equipment. The following lists provide support facility requirements for each station based upon conceptual design estimates:

Buildings

Main Compressor Building	(80' x 190')
Service Building	(90' x 140')
Office and Control Rooms	(30' x 60')
Fuel Gas Building	(30' x 40')
Auxiliary Building	(50' x 60')
Living Quarters	(40' x 100', 2 story building)

Permanent Housing

Bedrooms for ten full-time staff  
Guest Rooms for 20 maintenance personnel  
Kitchen  
Dining Room  
Recreation Room  
Laundry Room  
Common Bath and Shower Facilities

Helicopter Pad

A 125' x 125' gravel-surfaced helipad will be located inside the plot area of each compressor station. The helipad will be for visual flight rules (VFR) only.

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**Wilson Jones.**

### *JPO Question #3*

**Question:** *Provide the number and size of turbines, gas compressors, refrigeration compressors, heaters and relief systems proposed for each station, and any additional equipment that may impact air quality.*

#### **YPC Response:**

##### **Mainline Gas Compressors**

Each compressor station will be equipped with a single turbine driven centrifugal compressor to compress the pipeline gas.

A gas turbine/compressor set will be treated as a self-contained unit, having its own controls, inlet, outlet, bypass valves and pressuring, purging and blowdown system. Gas turbine/compressor unit controls will tie into station controls which will be linked to the operations control center via the Supervisory Control and Data Accumulation system (SCADA) to provide for either local or remote operation.

Turbine exhaust emissions result from the combustion of natural gas. Based upon preliminary design, a turbine capable of developing 36,000 horsepower will be required for driving compressors for the 42 inch three station system.

The pipeline gas compressor will be a multi-stage barrel type centrifugal compressor. The function of the compressor is to pressurize the transported gas to propel it down the pipeline. No combustion takes place. Emissions from compressor are limited to fugitive emissions from compressor shaft seals which may be utilized for fuel.

The compressor will be sized during the detailed design and equipment selection stage of each compressor station to accommodate range of flow conditions that encompasses the operating requirements to full capacity. Preliminary design estimates that compressors for this 42 inch three station system will require sizing to boost 1,700 psig suction pressure to the 2,220 psig discharge pressure.

##### **Temperature Control Systems**

The natural gas transported in the pipeline will be maintained at temperatures below or above the freezing point of water in order to match local thermal conditions. In the northern sections where soil conditions consist primarily of permafrost, the pipeline will operate at less than 32°F to maintain the frozen state of the permafrost. The pipeline will operate at temperatures above 32°F in the southern sections where the ground is not frozen. These temperature control measures will help minimize frost heave and thaw settlement concerns for the pipeline.

The change over from chilled gas to warm gas operation is defined as the cold to warm transition point. Based upon preliminary evaluation of general route geotechnical data, the TAGS pipeline transition point has been placed at Compressor Station C. This scenario requires refrigeration systems at Compressor Stations A and B and a heater at Compressor Station C.

Temperatures north of the cold to warm transition point will be kept below 32°F by the installation of refrigeration systems on the outlet of Compressor Stations A & B. Temperatures south of the transition point will be maintained by heaters on the discharge of the gas compressors if the temperature rise during compression is not sufficient. If significant advantages can be identified, the transition point could be placed anywhere south of Compressor Station C by the installation of a separate heater, as long as the gas flowing temperature remains above freezing.

A closed loop, external refrigerant gas will be used where refrigeration capability is required to chill the pipeline gas immediately after compression. The major refrigeration system components will include a compressor, condensers and natural gas heat exchangers.

Refrigerant gas will be compressed by a turbine driven centrifugal compressor. The turbine will utilize natural gas as fuel, exhausting combusted natural gas. The refrigeration turbines will be sized for specific power application requirements, as the chilling capacity required will vary from 5,000 to 18,000 hp. The compressor will be similarly sized at the appropriate stage of design. It will differ from the mainline compressors in that it will operate in a substantially lower pressure range. Emissions resulting from the refrigerant compressor will be fugitive emissions from compressor shaft seals which may be utilized for fuel.

Gas heating equipment, such as that currently identified for use at Compressor Station C, will be used to keep the gas above freezing to minimize problems in frost susceptible soil. The heater will utilize combusted natural gas to heat directly exposed pipes of natural gas in a heat exchanger. The size for the heater at Station C would be sufficient to handle a heating requirement of 148 MM BTU/hr.

### Relief Systems

All compressor stations will be provided with systems to allow for shutdown, station isolation and natural gas venting for either planned maintenance or emergency shutdown. These systems will be utilized only in adverse situations outside of normal operation.

### Utility Systems

A natural gas/diesel fuel/dual fired power generator capable of delivering 4,000 kilowatts is one of two utility systems generating emissions. The generator will emit combusted emissions dependent on fuel type. Diesel fuel will be utilized as a backup fuel when natural gas is not available from the pipeline.

The second emitter in utility systems would be a standby heater. This unit would be an indirect fired heater circulating a glycol/water mixture, utilizing natural gas, or diesel if no natural gas is available and capable of providing 20 MMBTU/hr to maintain indoor building temperatures. This heater would emit combusted hydrocarbons to produce heat to maintain the indoor temperature of compressor station buildings.

#### Station Piping & Associated Equipment

The valves and flanges associated with the compressor stations will emit fugitive emissions of unburned hydrocarbons. These fugitive emissions will be minimized as much as possible in accordance with sound operating practices.

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**Wilson Jones.**

## JPO Question #4

**Question:** Provide the calculated amount of particulate matter and exhaust emissions resulting from each station.

### YPC Response:

The compressor stations will utilize equipment identified in Response #3. The identification of particulate matter and exhaust emissions for the stations are shown below.

Table 1  
Compressor Station Emissions  
For a Station Requiring Gas Refrigeration  
(Design Concept for Compressor Stations A and B)

Mainline Turbine	1	36,000 BHP	215.00	35.00	15.00	*
Refrigeration Turbine	1	21,000 BHP	100.00	10.00	3.00	*
Power Generation	1	4,000 KW	15.60	5.90	1.39	0.79
Building Heater	1	20 MMBTU/Hr	1.40	1.20	0.40	0.16
Fugitive Emissions	Miscellaneous Sources		-	-	0.93	-
TOTALS			332.00	52.10	20.72	0.95

Table 2  
Compressor Station Emissions  
for a Station Requiring Gas Heating  
(Design Concept for Compressor Station C)

Source	Quantity	Size	Pollutant Emissions (lb/hr)			
			NO <sub>x</sub>	CO	UHC	PM
Mainline Turbine	1	36,000 BHP	215.00	35.00	15.00	*
Gas Heater	1	148 MMBTU/hr	10.36	8.88	2.96	1.18
Power Generator	1	4,000 KW	15.60	5.90	1.39	0.79
Building Heat	1	20 MMBTU/hr	1.40	1.20	0.40	0.16
Fugitive Emissions	Miscellaneous Sources		-	-	0.93	-
TOTALS			242.36	50.98	20.68	2.13

\* - Particulates are negligible for turbines burning gas

#### Abbreviations

NO<sub>x</sub> - Emissions of Nitrogen Based Oxides  
 CO - Carbon Monoxide emission  
 KW - Kilowatts  
 PM - Particulate Matter  
 UHC - Unburned Hydrocarbon  
 BHP - Brake Horsepower  
 lb/hr - Pounds per Hour  
 MMBTU/hr - Millions of British Thermal Units per Hour

#### Assumptions

1. Building Heaters and Gas Heaters emissions based on a staged type heater
2. Fugitive Emissions resulting from valves, flanges, etc.

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**Wilson Jones.**

## *JPO Question #5*

*Question: Identify the location of borrow sites to be used for the construction of each station.*

### *YPC Response:*

Identification of material sites to be used during TAGS construction will not be feasible until route characterization is complete and final pipeline design is underway. The following is provided as a general description of the requirements and sources of borrow material.

The location of each compressor station, either on a side slope or hilltop, will preclude or limit the use of additional fill from borrow sites as foundation sub-base. Each site will require removal of overburden material to level the site, and expose quality foundation materials such as bedrock. If suitable, the overburden material will be used as fill at each site to the maximum extent possible. Finish gravel for final grading and concrete work will come from nearby borrow sites.

Please refer to the December 1986 "Trans-Alaska Gas System Project Description" section 5.2.18, BORROW RESOURCES, for information regarding the general resource planning and locations of borrow to be used for the construction of each station. Section 5.2.18 of the Trans-Alaska Gas System Project Description identifies, by TAGS milepost, the general potential material sources and material types.

Compressor Station Site A is located at milepost 190.0 and is near potential alluvial gravel and sand material sites within the floodplain of the Dietrich River.

Compressor Station Site B is located at milepost 392.4 and is located on and near competent bedrock suitable for civil construction.

Compressor Station Site C is located at milepost 568.0 and is near sources of sand and gravel located on the alluvial fans of One Mile Creek, Darling Creek, and Bear Creek.

*MultiDex™*



**Wilson Jones.**

## *JPO Question #6*

**Question:** *Will the design changes cause changes in the location of the proposed communication system?*

### **YPC Response:**

TAGS will install and operate a communication system to provide for the exchange of voice and data information along the pipeline system. The system will provide for voice and data communication between all installed facilities (the compressor stations, block valve sites and the LNG/MT) and voice communication between mobile units.

It is currently envisioned that a microwave communication system would link the various TAGS facilities. The microwave system would require sites for communication facilities in proximity to the system within the utility corridor. These sites would be located on ridges or mountain tops (in a manner similar to communication facilities for TAPS) for point to point transmission of voice and data. Microwave tower sites would be selected during detailed design if co-use of existing communication sites is not feasible.

However, other options exist for TAGS communications. A fiber optic system would require installation of a continuous fiber optic cable in the pipeline right-of-way. Pipeline facilities such as block valves and compressor stations would be connected to the cable for voice and data transmission.

Satellite relay systems would require communication facilities at block valve and compressor stations to link up to overhead satellite. The satellite would link to ground based communication systems and the system supervisory control center for voice and data transmission.

Final selection of the communication system which provides the most effective coverage and reliability will be done during later stages of the project. Existing communication systems capability, system layout, current communications technology and perceived future requirements will be some of the considerations involved in the final selection of the TAGS communication system.

The design modifications change the communication system in so far as they reduce the linkup requirement for compressor stations no longer proposed. Communication system selection, the location of communications facilities or the location of the system supervisory control center (currently envisioned in Valdez) are not affected by the project modifications associated with increasing the pipe diameter to 42 inches and ramping up to full system design capacity.

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**Wilson Jones.**

### *JPO Question #7*

**Question:** *Are there any other alignment changes since the original application that are not portrayed on the 3 plats?*

**YPC Response:**

There are no additional alignment changes associated with the increase in pipeline diameter from 36 to 42 inches.

The TAGS 36 inch pipeline alignment was based upon routing criteria related to pipeline operating temperatures, route geotechnical conditions, and the avoidance of known geological hazards.

Since the gas temperatures within the 42 inch pipeline system will be maintained in a manner identical to the 36 inch system, i.e. the gas will be below 32°F throughout areas where permafrost conditions predominate, and above 32°F in areas of known thaw stable soils, no reroutes are necessary for the adjustment in pipe diameter.

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## *JPO Question #8*

*Question: Please provide an evaluation of noise levels associated with the design changes.*

### *YPC Response:*

There will be less noise generated during operation of the TAGS pipeline system due to the reduced compression horsepower requirements of the 42 inch pipeline. The previous 36 inch pipeline system proposed both a ten single turbine/compressor stations concept and a five station, two turbines per station concept. The 42 inch pipeline system will require only three single turbine/compressor stations.

The noise level associated with individual compressor stations will not increase. A single gas powered turbine/compressor unit will be used to compress the gas, while gas or diesel powered generators will be used for other power requirements. This is the same concept as the 36 inch, single turbine station design.

Pipeline construction will not experience increased noise levels from the increase to 42 inch diameter line pipe. Ditching, welding and laydown efforts will require the same types of equipment as the 36 inch pipeline. The noise duration however, will increase due to the increased ditch and linepipe size.

Noise related to compressor station construction will also be reduced due to the decreased number of stations.

The following evaluation of noise levels deals with a typical noise source, i.e. a turbine. Please refer to the supplemental information provided to Mr. Jules Tileston of the Bureau of Land Management as part of the TAGS EIS (February 23, 1987), and the Trans-Alaska Gas System Final EIS (June 1988) for additional information regarding noise.

Facility noise levels depend on several factors related to equipment selection, arrangement, orientation, enclosure and operating conditions. In addition, such environmental factors as ambient noise attenuation contribute to noise conditions. During detailed project design stages, noise levels, frequencies, and attenuation characteristics will be specifically evaluated for each facility site.

At each compressor station site, turbine driven compressor units and/or generator units are the significant contributors to noise generation. For purposes of simplification, noise levels have been obtained for a single assumed equipment type that could be used for turbine/compressor service at compressor stations based on TAGS conceptual definition. The following noise levels were provided by the manufacturer of the assumed equipment type as follows:

90	dBA @ 3'	distance from source
59	dBA @ 400'	distance from source

Generally, if the distance between a point noise source and a receptor in the far field is doubled, the sound level will decrease by 6 dB's. Applying this generalization for rough estimating purposes, sound levels are expected to be below background noise levels at a distance of 3000 to 4000 feet from any station location. Outdoor ambient noise levels less than 40 to 45 dBA are extremely unusual, but have been assumed as the minimum background noise levels for the TAGS project.

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## JPO Question #10

**Question:** Will the number of mainline block valves change?

### YPC Response:

United States Department of Transportation (DOT) Pipeline Safety Regulations - Part 192 - Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards outlines requirements for spacing of block valves. The requirements for block valve spacing is determined by the class location. The class location sets maximum distance requirements between block valves. Therefore, pipe diameter has no effect on the number of block valves required. The table below details maximum block valve spacing for DOT transmission lines versus class location.

BLOCK VALVE SPACING vs. CLASS LOCATION\*

PIPELINE CLASS LOCATION VALUE	MAXIMUM DISTANCE TO A BLOCK VALVE (miles)
4	2 1/2
3	4
2	7 1/2
1	10

The station valves associated with the previous compressor stations will no longer be required. Six new station valves will be at the inlet and outlet of the three new compressor stations.

\*Please refer to CFR Title 49-Transportation Part 192.5 and 192.179 for additional information regarding Class Locations and block valve spacing.

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## *JPO Question #11*

*Question: Is it possible to adjust the location of the compressor stations? If so, how much and what criteria should be used?*

### *YPC Response:*

It is possible to relocate compressor stations along the TAGS system. However, the amount of allowable adjustment is not a straightforward answer. It depends on the hydraulic evaluation of the system in conjunction with the application of site selection criteria. Each station will have different constraints due to placement of other stations as well as site specific considerations.

The compressor stations are located within an area that 1) does not exceed the power limitations of the appropriate turbine size, and 2) stays within 33% of the upper power limit at design rates to maintain high efficiency, minimize exhaust emissions and not degrade the useful life of the equipment.

These limitations determine the extent of the hydraulic "window" which the compressor station must fit in. The "window" represents the limits which a station can work in if the stations (or end point of the line) above and below are positioned at their "optimum location". This optimum location is identified as the center of the window and is determined by repeated hydraulic runs to identify that location as well as the area covered by the window.

The windows for the compressor stations are shown on Figures 11-1 and 11-2 attached. The "center" of the window identifies optimum positioning as per the hydraulic calculations. The window identifies the area which a compressor station would work if the station above it and the station below it are located at the "center" of their respective windows.

Each station is positioned within the window to minimize impacts of the stations on the surrounding environment and ensure construction and operational concerns can be accommodated. Because of this sighting effort within each window, system hydraulic calculations must be recalculated for site adjustments as it is doubtful that each station will stay on the center of its window.

This effort becomes an iterative process as environmental data and field observations require adjustments to site locations and adjustments to site locations require hydraulic evaluation, which may or may not require further site adjustments. It is not possible to provide a few simple rules of thumb for adjustment of station sites.

A system transporting a compressible fluid such as natural gas is much more sensitive to changes in station location than one which transports incompressible fluids, such as water or crude oil. This is due to the fact that the density of a compressible fluid continually decreases as the pressure decreases. This causes the friction loss (or pressure loss) per unit of length of the system to increase as the gas approaches the next compressor station.

Stations are located along a pipeline system to provide pressure energy into the fluid being moved through the pipeline. This pressure energy is dissipated as the fluid moves along the pipeline to overcome friction between the fluid and the pipe wall and within the fluid itself.

The total compression required for a given system configuration could be put in at the origin point of the system, as long as the pipeline were designed to withstand such high pressures. However, it is typically not efficient nor economical to do this, as the engineering considerations of an extremely heavy wall pipe along the whole route would likely destroy any project's feasibility.

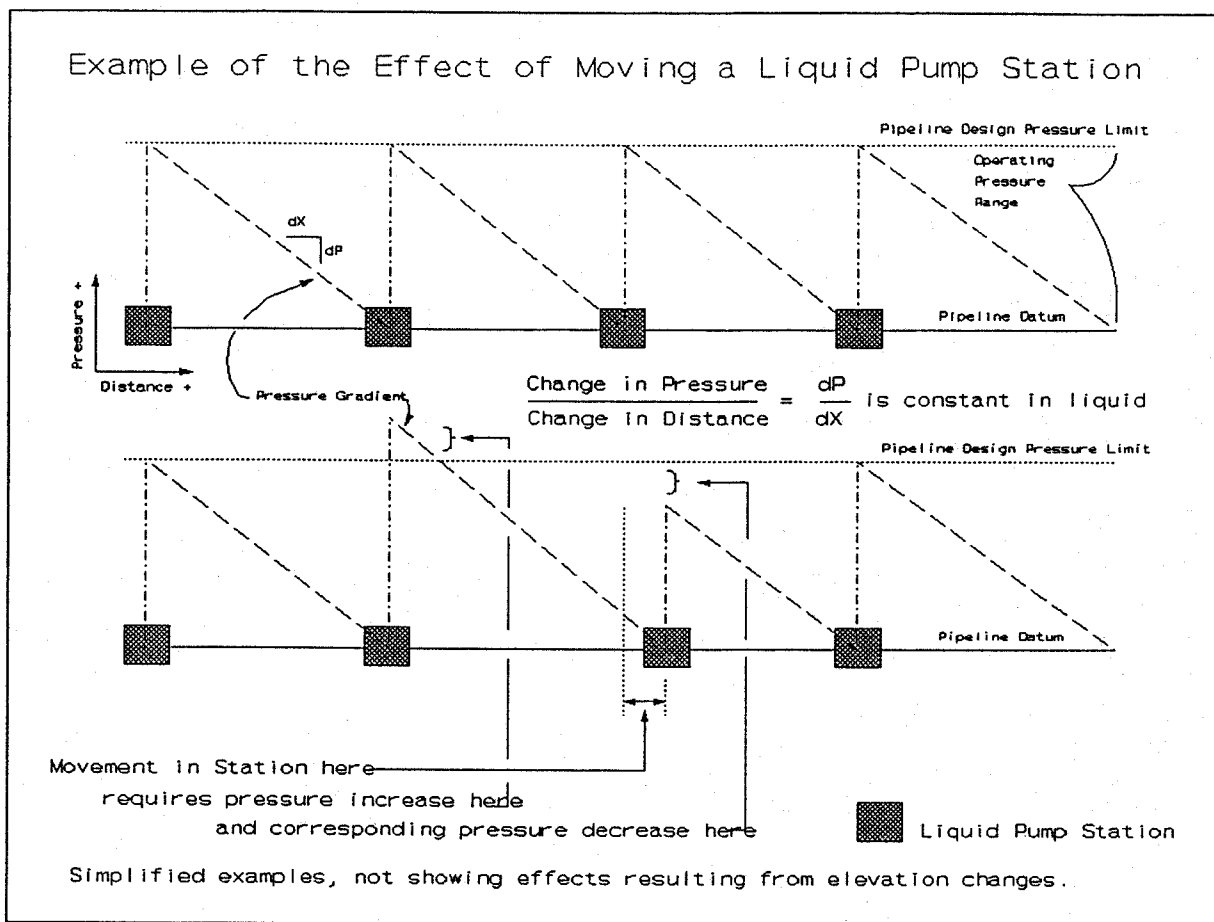
Stations are distributed equally along a pipeline system to distribute and minimize the energy requirements and keep system operating pressure within reasonable limits. While the spacing has little effect on the power requirements for a system carrying an incompressible fluid such as water or crude oil, it will effect the horsepower required on a system carrying a compressible fluid, such as natural gas.

This concept is easier to understand with visual examples. The following Figures 11-3 & 11-4 depict a hypothetical pipeline system. The horizontal axis represents distance along the pipeline system. The blocks represent station locations where pressure is input to the fluid. The vertical axis presents the amount of pressure in the fluid and is represented by the dashed lines identified as the pressure gradients. The maximum allowable pressure is shown by the horizontal line labeled "Pipeline Design Pressure Limit". The space between this line and the line labeled "Pipeline Datum" represents the normal pressure range of operation.

Figure 11-3 illustrates the effect on a system carrying incompressible fluids such as water or crude oil. The upper diagram shows a system where stations are equally spaced along the pipeline system; the pressure requirement (corresponding to the energy requirement for a specified flowrate) is equally distributed. The lower diagram shows what happens when proper spacing of the stations is not maintained. When spacing is altered for a station as shown in the diagram, the upstream station must put up additional pressure to meet the required inlet pressure at the next station. This relocated station puts up a correspondingly lower pressure as the distance the station must move the fluid is reduced.

However, it is important to note that the total system pressure requirement (corresponding to the system power and energy requirements) stays essentially the same for an incompressible fluid. The increase in pressure at one station is balanced by the decrease in pressure at the next station. The additional expense of this system would be the cost to increase the "Pipeline Design Pressure Limit" at the location of the station where additional pressure is required; this could be handled by utilizing thicker wall pipe in this area if the original design pressure limit is not sufficient as shown in the example.

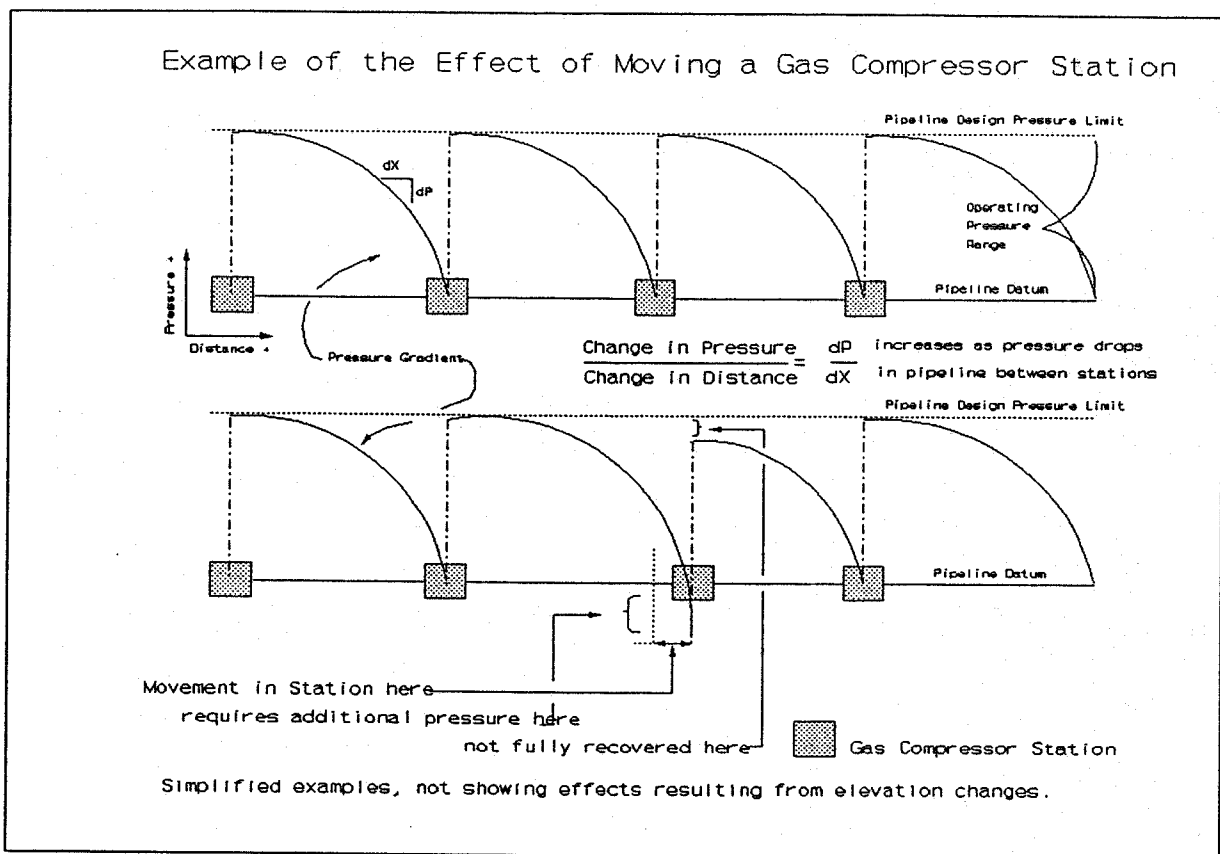
A system transporting compressible fluids (natural gas), such as TAGS, has additional considerations. The decreasing density causes the pressure gradient to take on a parabolic shape (shown in Figure 11-4), instead of a straight line as shown in Figure 11-3. Additionally, the discharge pressure of 2220 PSI is the discharge limit for modern compressor technology. Incremental pressure losses due to increased distance between stations causes reduced pressure at the inlet of the relocated compressor station. The pressure loss due to friction is much greater



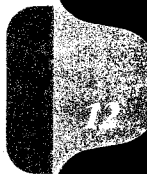
**Figure 11-3** Illustration of the Effect of Relocating a Liquid (incompressible fluid) Pump Station

at the lower pressures than at the higher pressures (1700-2220 PSI).

When a station is moved as shown in the bottom diagram of Figure 11-4, the net effect is a relatively high pressure loss in the pipe section upstream of that station. This will cause an increase in horsepower requirements for the station preceding the relocated station. The net effect can be an increase in horsepower to move the same volume of gas, decreasing the efficiency of the whole system.



**Figure 11-4** - Illustration of Effect of Station Relocation on a Gas (compressible fluid) system



## Question No. 12

**Question:** *Are there any geologic hazards associated with compressor station number 3(C)?*

**YPC Response:**

The site selected for Compressor Station C is located on an upland slope (200 feet above the Delta River) near Darling Creek. The site is located above the flood level of Darling Creek in an area consisting of 5 to 12 feet of glacial till over bedrock. Since the site will be graded and facilities located on bedrock there is no potential for soil liquefaction.

The analysis of aerial photography covering Compressor Station C area shows no evidence of rock or soil instability. Additionally, no evidence is present which would indicate that there is a potential for snow avalanche at the proposed site.

The Denali fault and the McGinnis Glacier fault are located approximately 15 miles south of the compressor site. The Donnelly Dome fault is located approximately 15 miles to the north of the site. All three of these faults have been active within the last 10,000 years and have the potential for generating an earthquake in the Alaska Range. There is potential, therefore, that the Compressor Station C site may experience ground shaking if any of these active faults generates an earthquake during the life of the project.

Compressor station sites in this high seismic potential area of the Alaska Range can be designed on either high strength thawed granular soils with low liquefaction potential, or bedrock. It is Yukon Pacific Corporation's preference for this high seismic area, to locate Compressor Station C on bedrock. A bedrock location will have a more predictable seismic response and will have lower ground accelerations than a soil site.

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### JPO Question #13

**Question:** What is the projected increase in ditch size and disposal requirements for unsuitable material?

**YPC Response:**

The projected increase in ditch size is six inches in both width and depth. The depth of cover, however, will be identical to the 36 inch pipeline since it is governed by CFR Title 49-Transportation Part 192.327. The following table outlines the cover depths versus Class Locations.

COVER DEPTHS vs. CLASS LOCATION\*

CLASS LOCATION	NORMAL SOILS (Inches)	CONSOLIDATED ROCK (Inches)
1	30	18
2, 3, 4	36	24
Drainage ditches of public road and railroad crossings	36	24

\*CFR Title 49-Transportation Part 192.327, Cover

Ditching requirements will increase by approximately 17 to 20 percent when normal ditch configurations are compared for both 36 and 42 inch pipelines.

In areas where excavated soils do not meet ditch backfill requirements, granular soils will be placed around the pipe to a depth of 12 inches above the top of pipe; then excavated soil will be placed over the granular material. All excess soils will be mounded over the general ditch excavation area. In areas where mounding volumes are greater than can be reasonably placed over the ditch, excess material will either be uniformly spread over the workpad area or disposed of into authorized sites, in accordance with approved disposal plans. Mounding or any other placement of spoil on the right-of-way will be in consideration of site specific cross-drainage characteristics.

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### *JPO Question #14*

*Question: Per our discussion please provide additional detail on the work force/work effort needed for the revised project and compare with the original proposal.*

#### *YPC Response:*

As per the discussion of August 24, 1992, Table 5 provided in the submission of July 29, 1992 has been revised to show manhours. The revised table is shown on the following page.

The bottom of the table presents a comparison of revised construction manhours compared to the previous estimate submitted in the June 1988 TAGS EIS. This result is also graphically illustrated on page 7 of the July 29, 1992 submission.

# Response JPO-14

## TAGS Project Employment in Alaska - Total Manhours Effort

### By Job Type - Construction Phase

YEAR	-4	-3	-2	-1	Start-Up	+1	+2	+3
JOB TYPE								
Construction Managers	3,117	35,726	164,177	167,294	163,203	12,383	15,482	14,162
Administrative Managers	3,117	35,726	164,177	167,294	163,203	12,383	15,482	14,162
Engineers	9,351	107,179	472,056	481,407	418,624	31,086	40,381	42,487
Engineering Technicians	3,117	62,345	102,749	187,771	127,711	12,383	15,482	14,162
Computer Technicians	3,117	62,345	102,749	187,771	127,711	12,383	15,482	14,162
Attorneys	3,117	25,079	45,416	48,533	46,789	12,383	15,482	14,162
Life & Physical Scientists	3,117	35,726	53,606	56,723	42,530	12,383	15,482	14,162
Public Relations	3,117	25,079	45,416	48,533	46,789	12,383	15,482	14,162
Labor Relations	3,117	35,726	123,225	126,342	92,218	12,383	15,482	14,162
Purchase Agents	3,117	62,345	102,749	85,390	56,726	12,383	18,514	14,162
Accountants	3,117	35,726	61,796	64,914	56,726	12,383	15,482	14,162
Bookkeepers	3,117	35,726	61,796	126,342	127,711	9,351	15,482	14,162
Secretaries	3,117	35,726	164,177	167,294	127,711	12,383	25,589	14,162
Data Entry Personnel	3,117	35,726	164,177	167,294	127,711	12,383	22,556	14,162
Clerks	3,117	35,726	164,177	187,771	127,711	12,383	15,482	14,162
Carpenters	9,351	266,893	717,770	288,138	340,744	31,086	30,274	42,487
Caterers	15,586	172,398	622,359	1,184,567	929,384	64,949	77,408	70,812
Concrete Workers	15,586	125,394	677,553	1,535,171	992,459	77,078	88,526	63,512
Electricians	15,586	178,632	616,125	1,143,615	816,013	61,917	77,408	70,812
Sheet Metal Workers	21,820	170,228	534,956	782,014	702,722	75,567	95,232	59,720
Laborers	56,108	722,933	3,180,429	4,268,536	3,624,365	228,967	275,637	301,639
Operating Engineers	15,586	391,584	1,598,981	1,965,171	1,426,273	64,949	86,504	114,609
Painters	12,469	89,668	206,234	728,097	483,259	40,438	47,777	50,810
Pipe Fitters	21,820	276,704	678,289	1,270,932	546,963	82,641	94,222	67,019
Welders	31,171	410,503	1,862,916	2,033,325	1,986,945	133,942	201,308	163,522
Teamsters	43,640	500,170	2,011,816	2,453,486	3,079,451	175,390	196,529	170,535
TOTAL WORK FORCE	311,713	3,971,021	14,699,871	19,923,724	16,781,648	1,238,346	1,548,161	1,416,237
Grand Total Manhours								59,890,721
Previous Estimate for TAGS	1,560,000	2,502,000	13,836,000	21,606,000	17,706,000	Previous Total	57,210,000	
Year by Year Difference	(1,248,287)	1,469,021	863,871	(1,682,276)	(924,352)	1,238,346	1,548,161	1,416,237
Cummulative Difference	(1,248,287)	220,734	1,084,604	(597,671)	(1,522,023)	(283,677)	1,264,484	2,680,721

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## *JPO Question #15*

*Question: How will the effects of frost bulb formation in streams be evaluated and mitigated if different for the 42 inch line?*

### *YPC Response:*

High ground water levels, typically encountered under streams, can create favorable conditions for frost bulb growth in areas of frost susceptible soils when a heat sink, such as a pipeline operating at less than 32°F, is introduced into the stream environment. The heat available within the surface water and stream bed could accommodate this adjustment to the thermal equilibrium if sufficient stream flowrates and temperatures exist. When the surface water and stream bed heat content is not adequate to keep the stream from freezing, mitigative efforts, such as deep burial and/or insulation can be utilized to thermally isolate the pipeline from the stream environment.

Elements affecting stream crossing design include the stream characteristics (soil types, soil and water temperatures, stream geometry, ground water conditions, terrain and surface features), and the pipeline operating conditions (gas temperature, flowrate, pipe geometry).

Diameter is the only condition which has changed. The anticipated flowrates of the gas do not change; therefore heat capacity of the pipe-gas system does not change. Gas temperatures along the pipeline will have slight variations compared to the 36 inch pipeline, but the minimum and maximum temperatures (those used for design considerations) do not change with pipe diameter. Therefore, the effect of the 42 inch pipeline on stream crossings is no different from the 36 inch pipeline.

Design of stream crossings will rely on the collection and categorization of typical stream crossing data used to define the thermal effects of a chilled gas pipeline on streams. The design methods and procedures for stream crossings will be developed during the appropriate stage of preliminary engineering to validate the stream crossing design parameters which encompass the possible range of conditions. Detailed design will utilize field data and the developed methods and procedures to develop a design for every stream.

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## *JPO Question #16*

*Question: The JPO and YPC have not agreed upon certain segments of the pipeline alignment (Galbraith Lake, Summit Lake, Atigun Pass, Keystone Canyon, Canyon Slough). Will changes in the alignment preferred by YPC result in changes to the compressor station locations now proposed by YPC?*

### *YPC Response:*

The segments of the pipeline alignment which require finalization will not add any significant length to the pipeline; many options may reduce route distance. Hydraulic conditions will be checked with any major adjustments, but it is perceived that there will be no effect on compressor station siting as a result of pipeline alignment changes.

Review of the TAGS EIS (4.2.19.5) does not identify routing concerns regarding the TAGS alignment through the area of Galbraith Lake.



### ***JPO Informal Request #1***

***Request:***      *Please provide topography for each of the three sites.*

#### ***YPC Response:***

Reference Drawings CSA-1, CSB-1 and CSC-1 (attached) for 1 inch = 800ft scaled topography of the compressor station sites.

### ***JPO Informal Request #2***

***Request:***      *Provide the engineering reasoning as to why Compressor Station Site C cannot be suitably placed between the highway and the Delta River.*

#### ***YPC Response:***

During the site selection process for Compressor Station C several sites were evaluated. In addition to the currently proposed compressor station site, a location west of the Richardson Highway between TAPS and the Delta River has been suggested.

The downslope site was rejected because of the lack of bedrock for foundations and the site is located on active floodplains.

The latter reason for rejection of the downslope site is the most important. Yukon Pacific Corporation siting criteria for compressor stations specifically requires location of these critical structures away from active floodplains. The Darling Creek, Bear Creek, and Delta River form floodplains throughout the downslope (west) side of the Richardson Highway in this area. The potential for flooding from Darling Creek is especially severe west of the roadway. This is exemplified by the very large high gradient granular alluvial fan deposited at the mouth of Darling Creek. Darling Creek as well as Bear Creek to the north and One Mile Creek to the south are well known for flash floods during the spring and summer months. These flash floods are extreme events which can deposit tens of feet of material and rapidly change course to any part of the alluvial fans. The high deposition rates of these events allow these streams to rapidly overwhelm roadway embankments and flood control dikes.

Due to the potential for flooding of a site West of the Richardson Highway and other geologic considerations identified in response No. 12, the upland site on the east side of the Richardson Highway is required.

### ***JPO Informal Request #3***

***Request:***      *Describe the condition surrounding stream crossing design and YPC's current plans for completing stream crossing design work.*

***YPC Response:***

Please see response to Question #15.

***JPO Informal Request #4***

***Request:***      *Please identify intentions for long term water sources for the compressor station operation.*

***YPC Response:***

Compressor station operations will not require the use of water in compression, refrigeration, heating or other auxiliary processes. Water use will be only as required to satisfy human requirements and other general non-industrial uses. Because these needs identify low water usage, it is likely that trucking water will be the preferred alternative. However, until the operational need can be fixed, it is not known whether trucking water or use of a nearby stream source is most suitable and environmentally acceptable. This request must be deferred until the appropriate stage of design development.

***JPO Informal Request #5***

***Request:***      *Please provide additional information regarding the compressor station sites, including location, site selection logic, and photography.*

***YPC Response:***

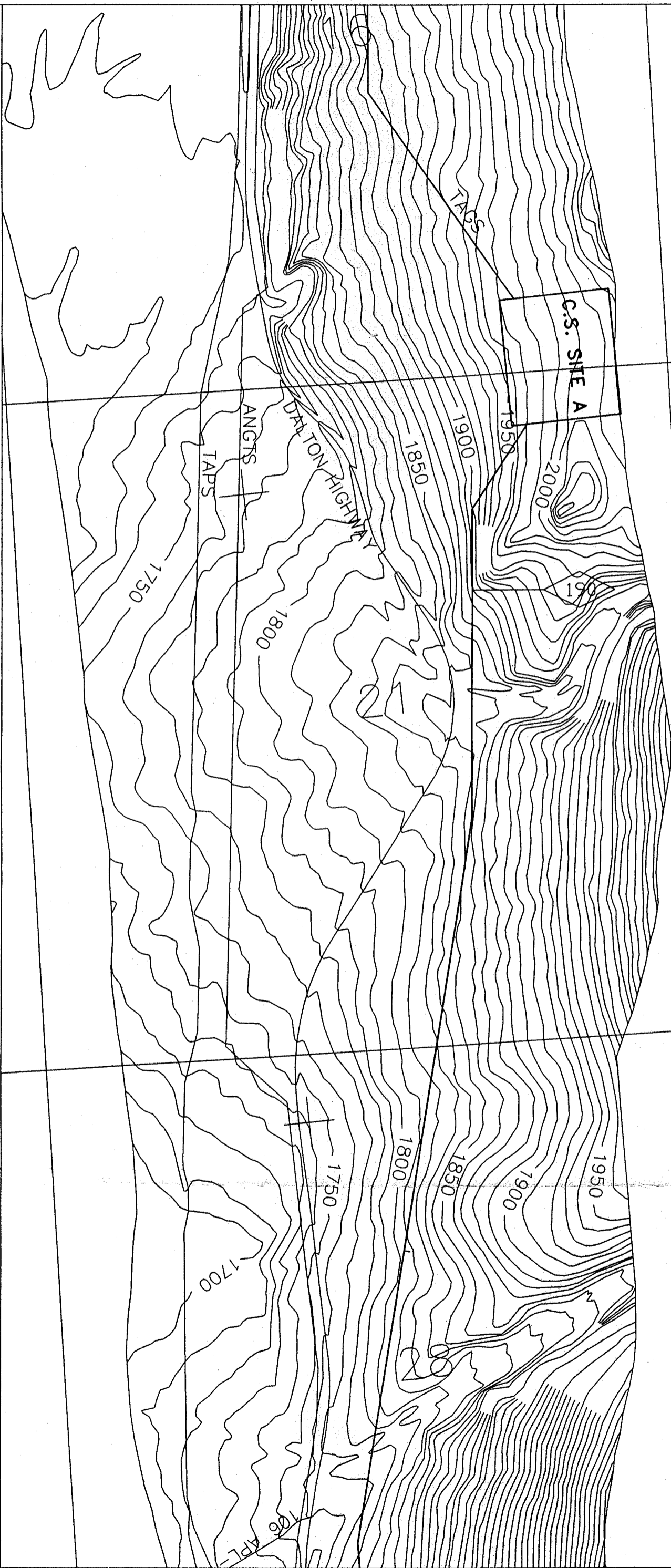
A booklet was distributed on the 9/9-10/92 field trip identifying these areas of interest. This document, entitled 42 Inch Pipeline Compressor Station Site Selection has been updated with improved photography and is attached to this submittal as Document IR#5. For additional information, please see the July 29, 1992 Project Revisions submittal as well as other responses of this request.



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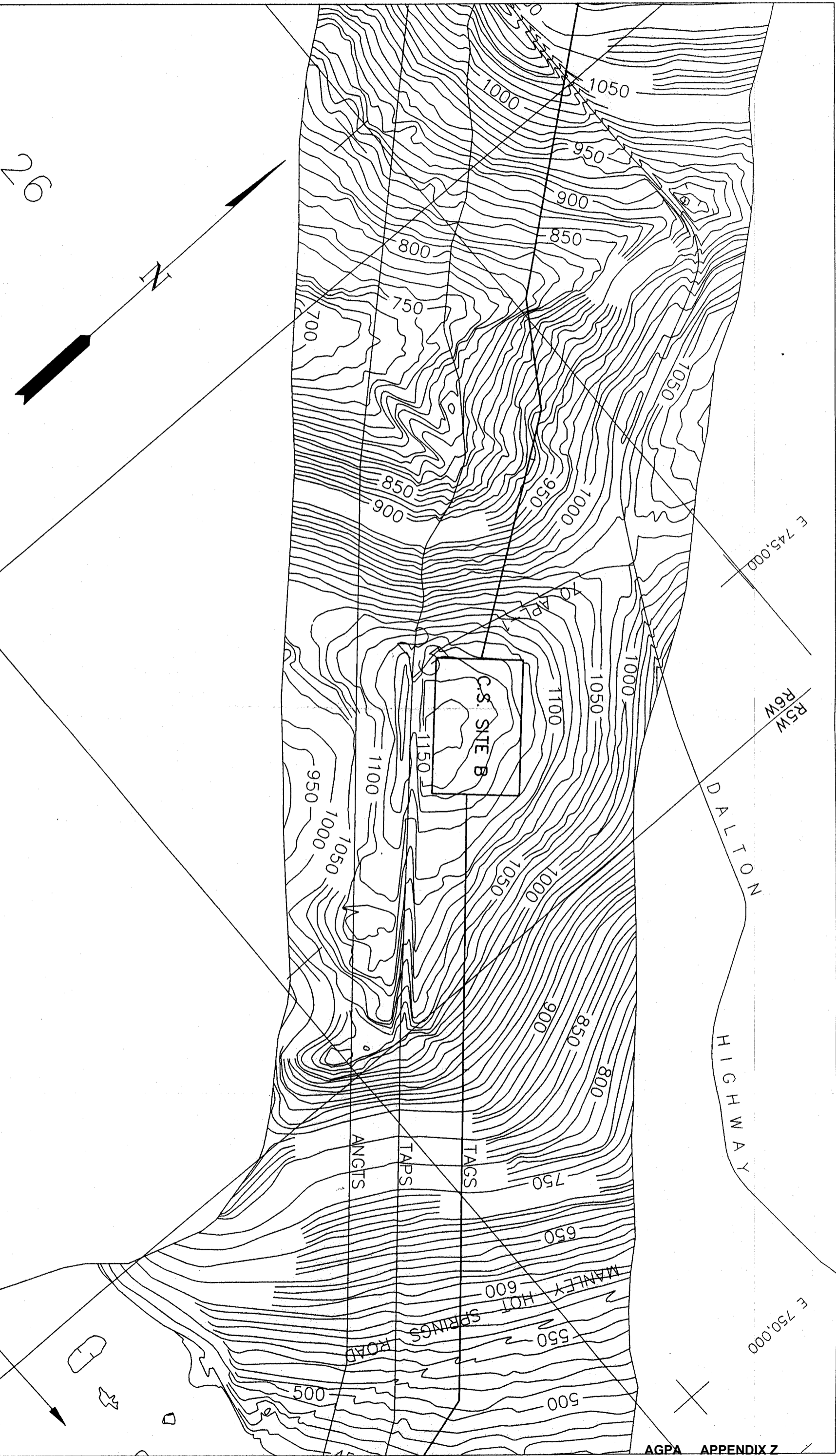


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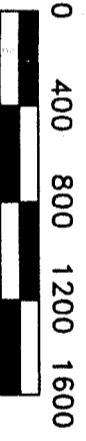
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BY: CAW

C.S. SITE A  
WITH  
TOPOGRAPHY






26



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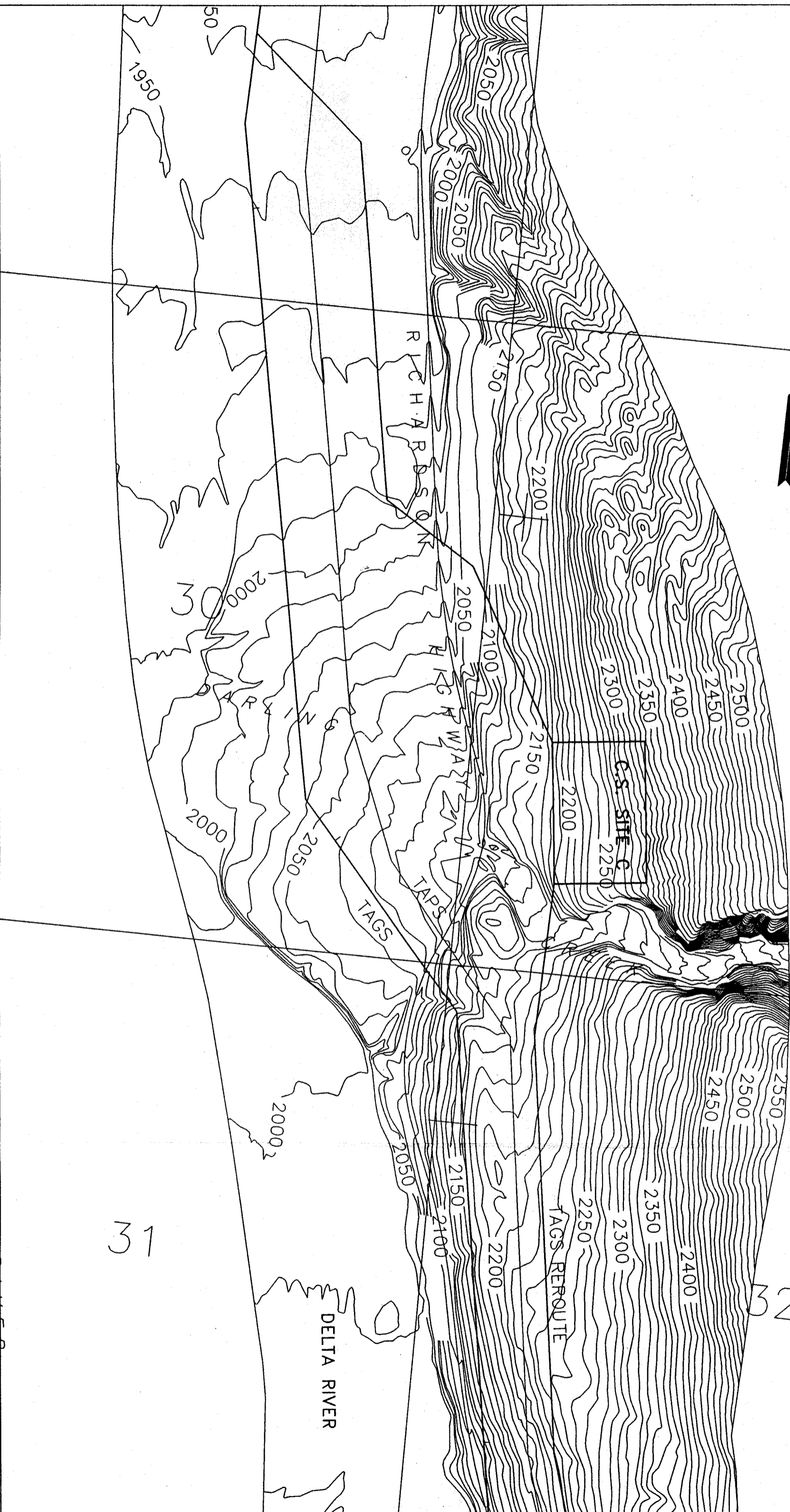
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FILE NAME:	CSB1.DWG		
BY:	CAW		




29

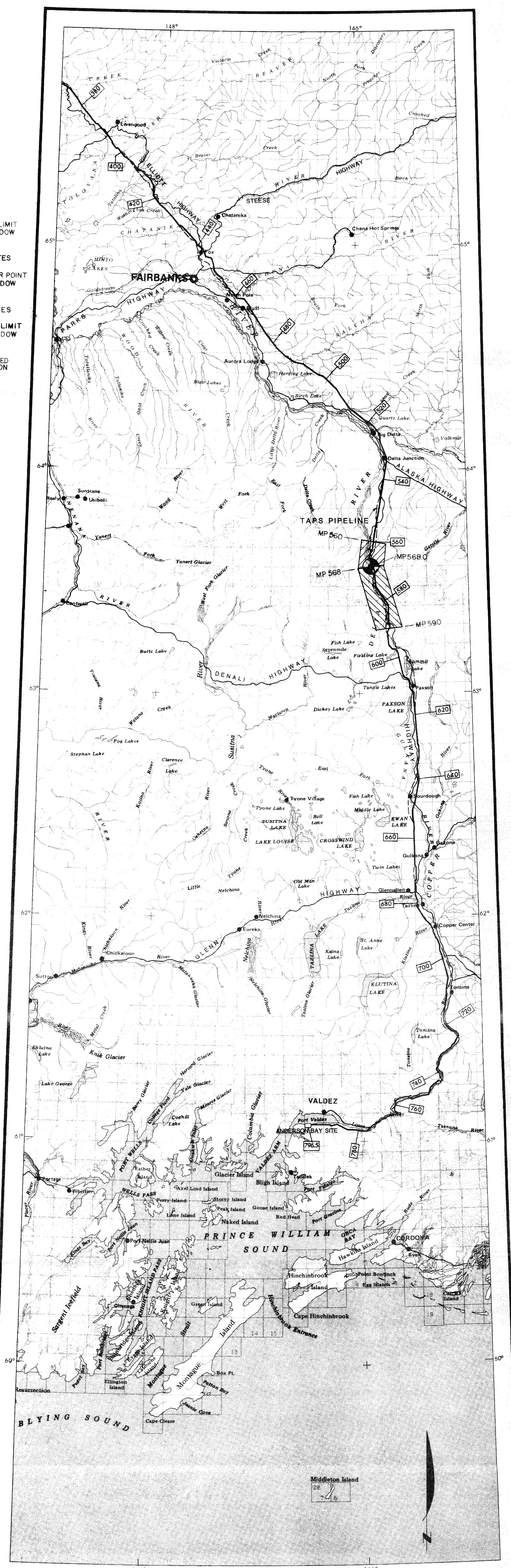
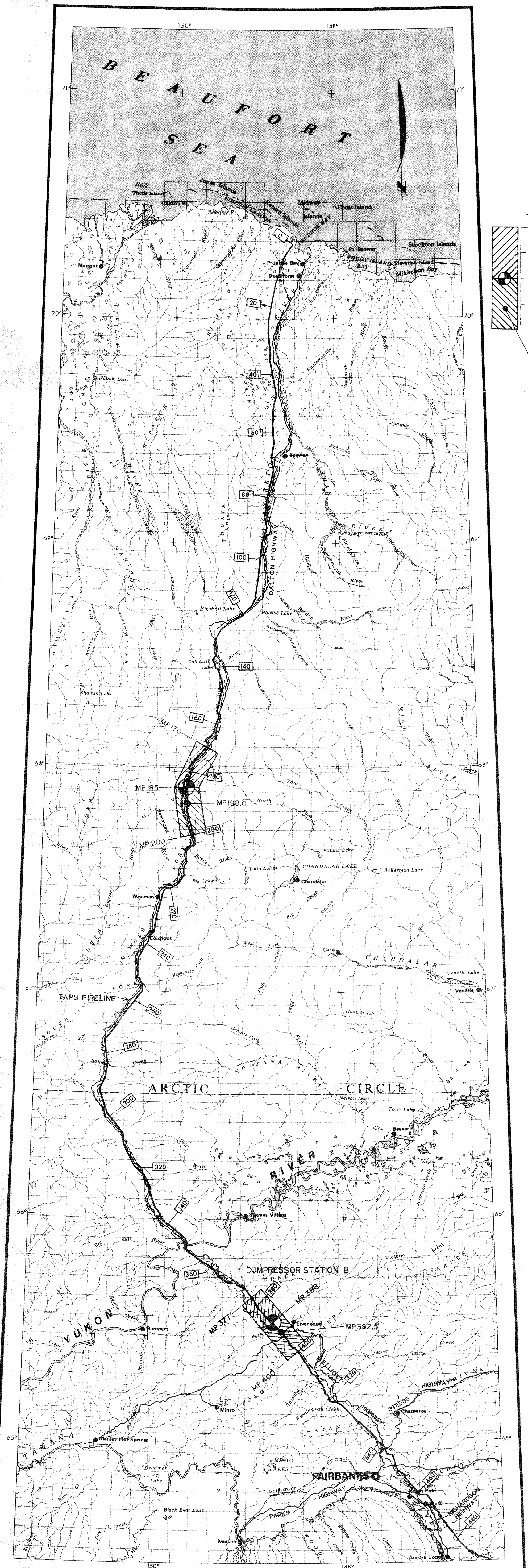
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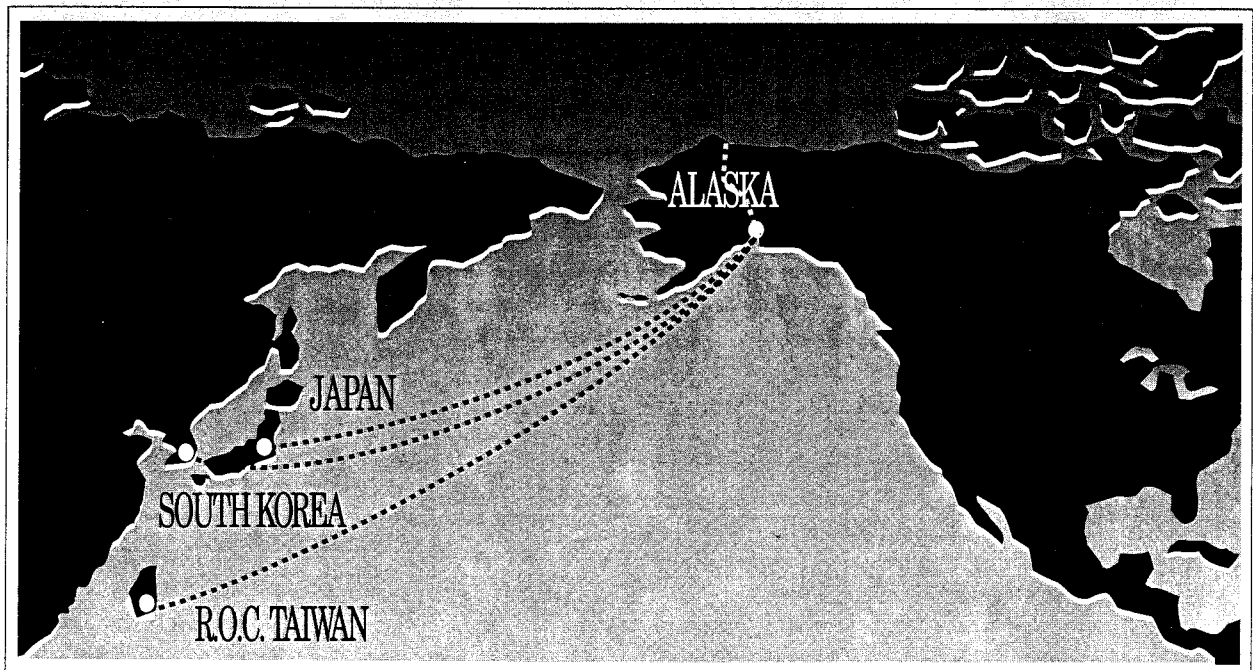






# Trans-Alaska Gas System (TAGS)

**42 INCH PIPELINE  
COMPRESSOR STATION  
SITE SELECTION**



## 42 INCH PIPELINE COMPRESSOR STATION SITE SELECTION

### **Station Requirements for the 42 Inch System vs. Capacity**

A significant advantage of the 42 inch system is the reduced number of compressor stations and the delayed requirement for additional compression along the pipeline. A total of three stations (in addition to compression requirements on the North Slope) are required to achieve the 14MMT volume.

### **Siting Requirements for Compressor Stations**

The spacing and siting of stations is ultimately carried out in two phases of work that are broken down into the "Macro" and "Micro" analysis.

The macro analysis involves setting station "hydraulic windows" along the route which each station can fit within and maintain good hydraulic efficiency.

- 1) Windows were set for the line because each station site depends on the location of the stations before and after. Each station may be moved if the other stations are moved correspondingly and the initial and final site do not cause any restrictive conditions, such as exceeding horsepower capabilities of turbines under consideration, or needing too little horsepower, causing the turbine to operate at a low efficiency level, increasing emissions and ultimately reducing the useful turbine life.
- 2) The TAGS system analysis considered two configurations for Macro analysis.
  - A) These were appropriately labeled the North Alternate and the South Alternate. Each provided essentially the same horsepower requirements versus capacity, but had different positioning for the intermediate stations.
  - B) The exception for this concept was the south end of the line, which will operate under a "warm gas" mode (above 32°F) while the remainder of the line operates as a "chilled gas" system (below 32°F). The operation of a pipeline in a chilled gas mode is more efficient than turbines operating in a warm gas mode. This causes slight adjustments for the site selection.
  - C) The siting options within each set of alternates were then considered on a cursory "micro" level to determine which set of alternate windows provided the best site selection conditions based upon the site selection criteria established. The south alternates provided the best conditions overall were examined in detail on a micro basis to identify the most desirable site within the window for each station.
  - D) A micro analysis was carried out for each window in regards to

environmental considerations, geotechnical conditions, access requirements as well as any other site specific conditions which might affect station operation or construction.

1. Environmental considerations include, but were not limited to the following:
    - a) Wildlife Habitat - the presence of wildlife use in the general area for grazing, birthing or endangered species restraints.
    - b) Fishery Habitat - whether or not construction or operation would affect nearby rivers, streams or lakes supporting fish populations.
    - c) Raptor concerns - whether or not the site would cause disturbance to falcon or eagle nesting and hunting territories.
    - d) Vista - each site was evaluated to ensure any disturbance of vista was minimized when compared to alternates.
    - e) Airshed - site selection was dependent on the ability to prevent station emissions from compounding other emission sources, or interfering with populated areas.
  2. Geotechnical review consisted of:
    - a) Presence or absence of frozen ground.
    - b) Identification of the site soil conditions and their suitability for foundation support of the station buildings.
  3. Access considerations consisted of minimizing road length so as to minimize environmental disturbance, station construction and maintenance costs.
  4. Other considerations consisted of:
    - a) Proximity to population centers
    - b) Proximity to TAPS pump stations
- E) The results of the analysis are identified in the following sections of this report.

# YUKON PACIFIC CORPORATION

Trans-Alaska Gas System (TAGS)

Compressor Station site Selection for 42 inch Pipeline System

Summary Sheet

Station	Selected Site (MP)	Land Ownership	Soil Conditions	Environmental Considerations	Geographical Description	TAGS 1"/1Mi A/S No.	TAGS 1"/1000 ft. Sheet No.	TAGS 1"/1000 ft. Sheet No.	Alyeska G-100 Sheet No.
A	190.0	BLM	Frozen (Retrans Deposits) Fine grain silt rich in organics over glacial till (FS/Gt)	Adjacent to but not in Snowden Mtn. ACEC & raptor nesting areas. Good Airshed. No vista disturbance.	Central Brooks Range of the Arctic Mountain Province UBD of the State of Alaska a portion of the Western quarter of Section 28 of Range 10 West, Township 35N in the Fairbanks Meridian	9 of 31	34 of 141	35 of 143	
B	392.5	State (Patented)	Frozen (95% - 100%) sedimentary bedrock	No wildlife/biological concerns identified. No airshed concerns. Vista disturbance minimal due to undulating terrain	Livengood Upland of the Interior Province UBD of the State of Alaska a portion of Section 25 of Range 6 West, Township 8 North of the Fairbanks Meridian	16 of 31	69 of 141	71 of 143	
C	568.0	BLM	Unfrozen Granular Alluvial Fan	Adjacent to but not in area set aside for Dall Sheep lambing area. No apparent vista disturbances.	Delta River lowland of the Alaska Range Province UBD of the State of Alaska, a portion of section 19 of Range 10 East Township 14 South in the Fairbanks Meridian	23 of 31	101 of 14	102 of 143	

## **Compressor Station A**

### **Site Description**

Compressor Station site A is located at MP 190 of the TAGS pipeline. It is on the East side of the Dalton Highway in the drainage basin of the Dietrich river as it flows south from the Brooks Range. The site is on an uplift approximately 1500 ft from the road, and sheltered from the south by a gentle uplift that the road detours by moving away from the river.

The area geology consists of apparent bedrock outcrops, yielding a high probability of bedrock foundations. Standing water is evident by the road, but begins to dissipate as one moves away from the road upland towards the compressor station site.

### **Discussion of Alternatives**

Alternatives to this site are first broken into the two basic levels: The first is the large scale consideration for all stations placement; the second is the micro positioning within the immediate area.

The "macro" positioning put the station in a window as far north as MP 170 and as far south as MP 200. MP 170 would be acceptable for the hydraulics, but the extreme beauty of the site and significant vista (Chandalar Shelf) made this site unattractive. There were no feasible solutions from this site to MP 185. This, along with the less desirable northern alternates for other sites made the northern alternates the least favorable for Compressor Station A, and attention was given to the southern alternatives.

Within the "Micro", sites from MP 185 to 200 were evaluated. MP 185 is not an acceptable location due to the fact that the northernmost spruce tree is located there, along with a tourist attraction and rest stop. Areas south of 192 are not feasible due to their direct interference with the Snowden Mountain Area of Critical Environmental Concern (ACEC) (1989 Utility Corridor EIS). This limited the selections to the level slopes around 189 to 191. MP 190 was selected due to the reduced cross slope as access, airshed, vista and other considerations were approximately equal.

### **Environmental Considerations**

This site has no identifiable concerns in regards to airshed, vista or wildlife. The stream to the south appears too small to accommodate any fish habitat areas. The site is near, but not in the Snowden Mountain ACEC.

### **Access Considerations**

Access is not a concern as the site is within 1500 ft. of the Dalton Highway.

COMPRESSOR STATION A  
AERIAL PHOTOGRAPH (78% OF ACTUAL SIZE)

North

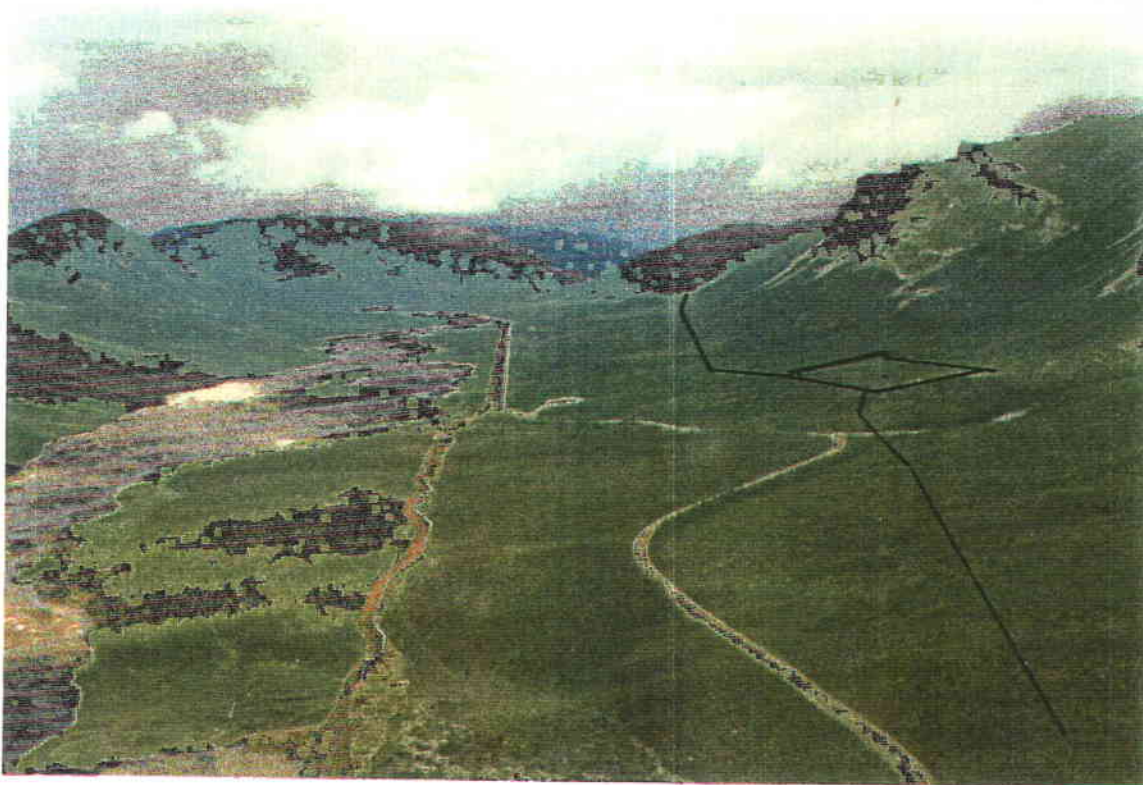


SELECTED SITE - COMPRESSOR STATION A

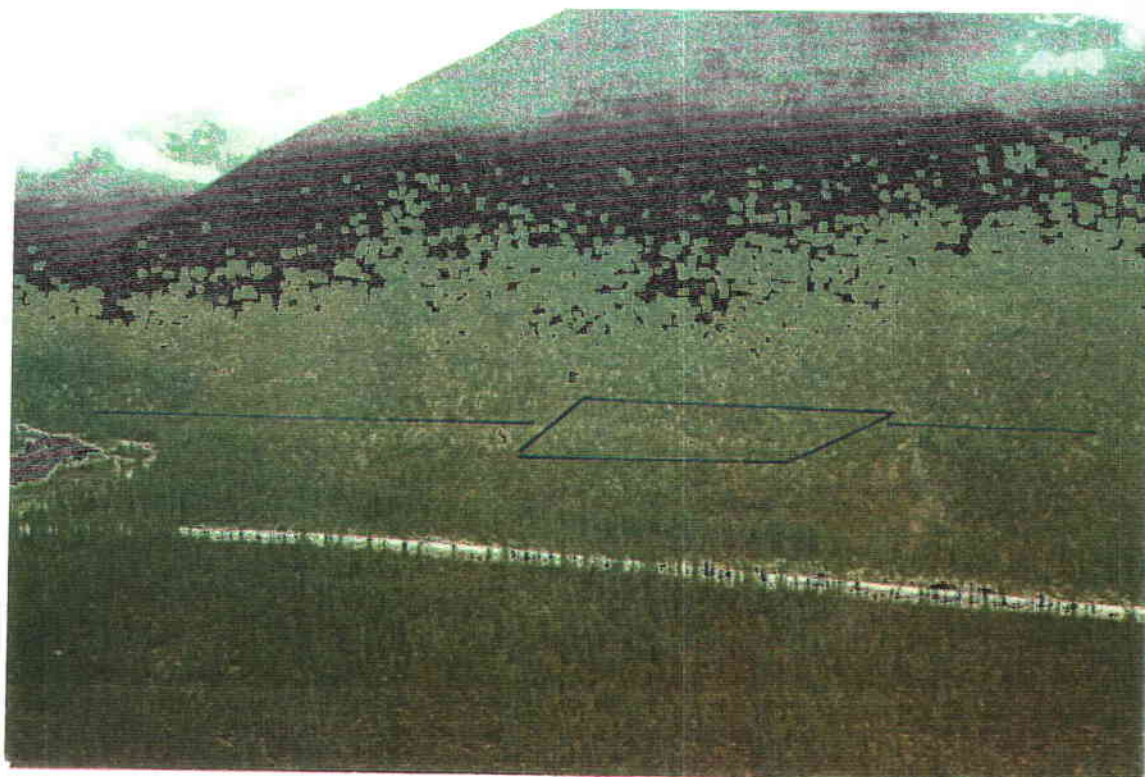
ALTERNATE SITE - COMPRESSOR STATION A

AGPA

**COMPRESSOR STATION SITE A  
AREA PHOTOGRAPHS**



**COMPRESSOR STATION A - SELECTED SITE  
(ALTERNATE SITE IN FOREGROUND FROM HIGHWAY CURVE)**



**CLOSE UP VIEW OF ALTERNATE SITE - LOOKING WEST TO EAST**

**PERSPECTIVE OF COMPRESSION STATION A  
LOOKING NORTH FROM BEDROCK KNOB  
(DIETRICH RIVER TO EXTREME LEFT)**



## Compressor Station B

### **Site Description**

Compressor station B is located at MP 392.5 of the TAGS system, in the Livengood Uplands of the Interior Province. The Livengood Uplands are characterized by rolling hills and dense black spruce. The site is no exception to this, except that the specific site is at the top of a knob hill, not in the line of sight of the high ridge 8 miles to the north. The site is north of the Tolovana River drainage area and approximately 3 miles NE of the old Livengood construction camp site used by Alyeska. The Alyeska pipeline right-of-way forms the southwest border of the compressor station site.

Soil conditions at the site are characterized by well drained frozen sediment bedrock. This will support an on grade foundation.

### **Discussion of Alternatives**

The Macro analysis of site selection included the window from MP 377 to 400. Many good sites exist on the north end, but access problems (5-8 miles) favored the South alternates, as was favored for the majority of the other sites.

The south alternates for compressor station B are limited by access as the prime consideration, although some consideration was given to the avoidance of the Tolovana River lowland area as the airshed and the groundwater conditions would cause additional concerns. This limited the selection to the area from 390-393, with 392.5 providing the best options in terms of soil, topography and access without additional disturbance due to access or vista.

### **Environmental Considerations**

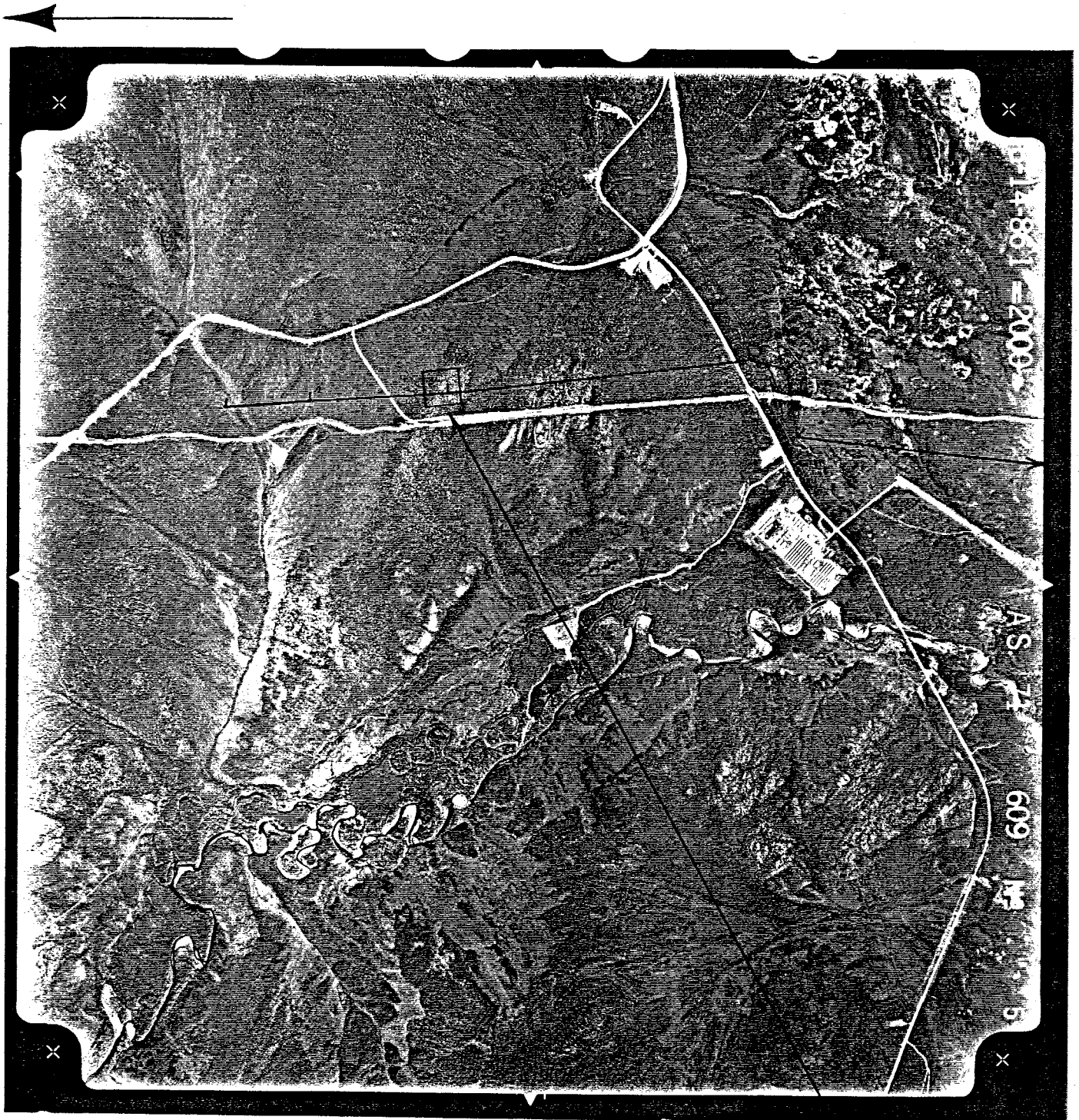
There are no known wildlife, fishery, or raptor concerns for this site. The airshed has no TAPS concerns, and is in an area that will not restrict emissions distribution.

### **Access Considerations**

The site is accessible by an existing TAPS access road bordering the north side of the site. The site is approximately 1/4 mile southwest from the Dalton Highway using TAPS access road 70-APL-1.

COMPRESSOR STATION B  
AERIAL PHOTOGRAPH (78 % OF ACTUAL SIZE)

North



COMPRESSOR STATION B SELECTED SITE

AGPA

APPENDIX Z  
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COMPRESSOR STATION B SITE  
AREA PHOTOGRAPHS



AERIAL VIEW OF SELECTED SITE  
(TAPS ROW IN BACKGROUND: ACCESS ROAD TO THE RIGHT)



VIEW FROM TAPS RIGHT OF WAY  
(RIGHT OF WAY USED AS MATERIAL SITE)

*COMPRESSOR STATION B SITE  
AREA PHOTOGRAPHY*



*VIEW OF THE EXISTING ACCESS ROAD TO THE SITE*

## Compressor Station C

### Site Description

Compressor Station C is located at MP 568, along the Delta River lowland of the Alaska Range Province. The site is uphill from the Richardson Highway and TAPS along the uplands slowly rising from the Delta River.

The site consists of shallow bedrock covered by till. This site will support an on grade foundation.

### Discussion of Alternatives

Because the pipeline changes from chilled to warm gas operation at Station C, the spacing, and consequently the hydraulic window for Station C changes relative to stations farther north. The window becomes tight on Station C as it is desired to move farther north to benefit the operating requirements of the previous station (horsepower limitations of one turbine). This places the optimum window in the area from MP 565 to 574.

Areas south of 570 were not considered due to their proximity to the Military Installation at MP 574 (Black Rapids Training Center). The final site was selected based upon noninterference with any environmental concerns and had good overland access for the station as well as the satisfactory routing for the pipeline. The final site and pipeline route into the station eliminates any concerns for the Wild & Scenic Rivers classification which the Delta river has south of the Black Rapids Training Center.

### Environmental Considerations

The site has no known environmental restrictions. It is adjacent to, but not in, a dall sheep lambing area higher up in the Alaska Range.

### Access Considerations

Site access is not a concern since the site is adjacent to the Richardson Highway.

COMPRESSOR STATION C  
AERIAL PHOTOGRAPH (78% OF ACTUAL SIZE)

North

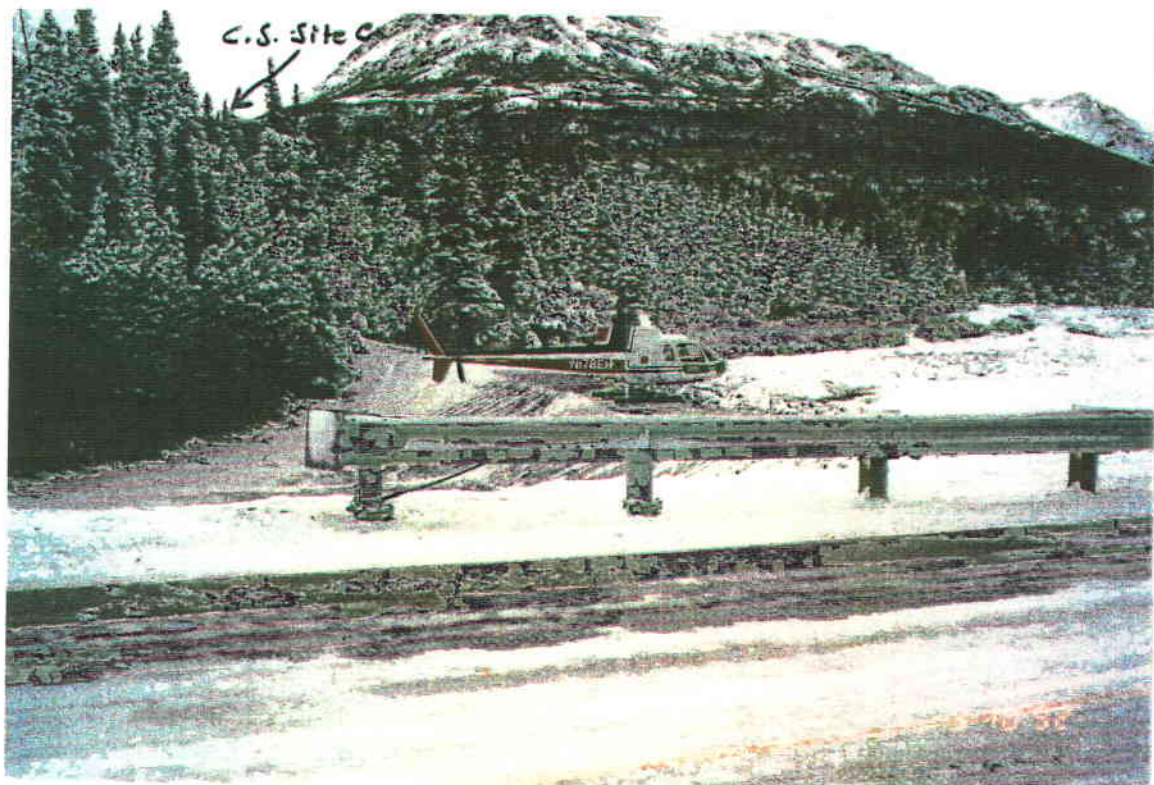


COMPRESSOR STATION C SELECTED SITE

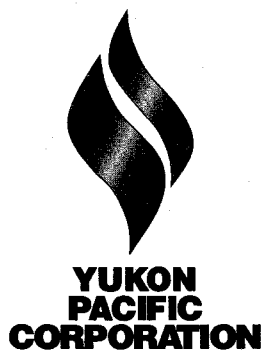
**COMPRESSOR STATION SITE C  
AREA PHOTOGRAPHS**



**AERIAL VIEW OF SELECTED SITE  
(LOOKING NORTH TOWARDS DONNELLY DOME)**



**VIEW OF HIGHWAY CROSSING AT DARLING CREEK  
(SITE C UP ON HILLSIDE TO LEFT)**



Yukon Pacific Corporation

1049 West 5th Avenue

Anchorage, Alaska 99501-1930, USA

PHONE: (907) 265-3100

FAX: (907) 265-3180/3190